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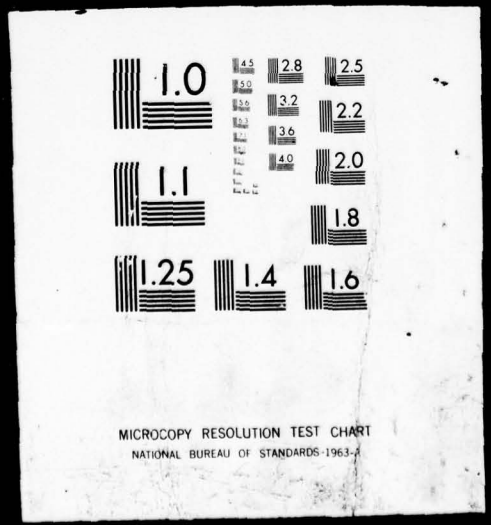

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OHIO RIVER BASIN
SHENANGO RIVER, CRAWFORD COUNTY

PENNSYLVANIA

NDI No. Pa. - 176
PYMATUNING RESERVOIR

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM,

Pymatuning Reservoir (NDI PA-176),
Ohio River Basin, Shenango River,
Crawford County, Pennsylvania. Phase I
Inspection Report.

(15) DACW31-78-C-0052

PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

(12) 81p.

(11) AUGUST 1978

LEVEL II

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Pymatuning Reservoir

Pennsylvania

Crawford County

Shenango River

28 July 1978

Inspection Team - GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

Contract No. DACW31-78-C-0052

Based on a visual inspection, as well as available engineering data, the dam is considered to be in fair condition. A brief hydraulic and hydrologic analysis indicates that the project is capable of passing and/or storing the runoff resulting from a storm of PMF magnitude without overtopping the dam. Thus, the spillway capacity is adequate.

The gate controls for the primary outlet system (consisting of two 6- by 8-foot concrete culverts) are deteriorated and in need of repair and replacement. Also, the deteriorated concrete in the outlet conduits should be repaired.

A swampy area is located along the toe of the embankment near the left abutment. This condition may be the result of poor drainage characteristics downstream of the dam since the structure is reportedly provided with a gravel toe and a blind drain with no apparent outlet. No seepage was observed issuing from the area above the toe at the time of inspection. It is recommended that the swamp be drained and that flow from the area be gauged and recorded. The measurements should then be transmitted to the appropriate agencies within the PennDER for an engineering review of the data. Additional investigations and/or remedial work may be necessary if the weir readings are deemed excessive or anomalous.

It is also recommended that the burrowing animals on the downstream face be exterminated and their burrows filled.

A warning system should be implemented to provide for the safe evacuation of downstream residents in the event that emergency conditions develop and the dam should be inspected on an annual basis to check for hazardous conditions which might develop.

GAI Consultants, Inc.

Bernard M. Mihalcin

Bernard M. Mihalcin, P.E.

Approved by:

C. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Date 8 Sept 78

Date 22 Sep 78

Overview Photograph of Pymatuning Dam

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
PYMATUNING RESERVOIR
NDI# PA-176, PENNDER# 20-7

SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

~~1.1 Purpose~~.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. The dam, located at Pymatuning Reservoir, is an earth embankment approximately 2,400 feet in length with a maximum height of 50 feet. The facility is equipped with both a primary outlet works and an emergency spillway. The primary outlet works consists of two 6 feet by 8 feet concrete box conduits with intakes located at the gate house. Flow is regulated by means of four manually controlled sluice gates operated from within the gate house.

The emergency spillway has a masonry-lined approach channel equipped with a concrete, ogee-shaped weir crest. Flashboards have been installed atop the crest of the weir. Immediately downstream of the weir, the spillway channel is spanned by a pier-supported concrete road bridge.

b. Location. The dam is located along the Shenango River Channel in the southern portion of Crawford County, Pennsylvania, approximately 500 feet northeast of U. S. Route 322. The community of Jamestown, Pennsylvania, is located approximately 1.5 miles southeast of the embankment. The dam, reservoir, and watershed are contained within the Greenville West, Linesville, Hartstown, Conneaut Lake, Harmonsburg, and Beaver Center U.S.G.S. 7.5 minute Pennsylvania quadrangles. In addition, a portion of the reservoir and watershed are contained within the Leon, Pierpont, Andover, and Kinsman U.S.G.S. 7.5 minute Ohio quadrangles. The coordinates of the dam are N41¼ 29.9' and W80¼ 27.7'.

c. Size Classification. Large (50 feet high, 188,000 acre-feet storage capacity at normal pool).

d. Hazard Classification. High. (See section 3.1.c.4.)

e. Ownership. Pennsylvania Department of Environmental Resources.

f. Purpose of Dam. The Pymatuning Act specifically provides that the primary purpose of the Pymatuning Reservoir shall be for the conservation of waters entering the Pymatuning Swamp and for regulating the flow of water in the Shenango and Beaver Rivers. The use of the reservoir for recreation and flood control are secondary purposes made possible under the act.

g. Historical Data*. Under instructions contained in the Act of the General Assembly approved the 14th day of June, 1911, the Water Supply Commission of Pennsylvania made preliminary surveys and studies to examine the feasibility of converting Pymatuning Swamp into a storage reservoir, and submitted a report to the legislature in 1913, stating that, "As a result of this study, the Commission is assured of the desirability of its construction, and the feasibility thereof, the resulting benefits accruing to the State at large, as well as to the various communities along the stream."

In the years following, there were many legislative acts to provide funds and establish authority for continued work on the project. Through these acts, and with the help of private interests, appropriations were made so that all necessary lands could be purchased, including 4,830 acres in the state of Ohio. Legislation was enacted in that state authorizing the state of Pennsylvania to flood the portion of the proposed reservoir now located in Ohio.

The contract for construction of the dam was awarded on September 8, 1931, and the dam was completed in 1933. Other parts of the project, including the Andover-Espyville Causeway and the constant level weir, and railway fills near Linesville, were completed in 1934. Permanent regulating gates to control releases from the reservoir, were installed in the fall of 1933.

1.3 Pertinent Data.

a. Drainage Area. 158 square miles.

*The above is an abridged version of a section in the "Operations and Maintenance Manual for Pymatuning Reservoir."

b. Discharge at Dam Site. Discharge records are available at this facility; however, the maximum high water level was not readily ascertainable. Conversations with Pymatuning State Park personnel present the day of inspection, indicated that the emergency spillway has never discharged.

Outlet Works Conduit at Operating Pool Elevation - Discharge curve not available.

Ungated Spillway Capacity at Maximum Pool Elevation ≈ 17,150 cfs.

c. Elevation (feet above mean sea level).

Top of Dam - 1,020.

Maximum Pool Design Surcharge - Not known.

Maximum Pool of Record - Not known.

Normal Pool - 1,008 (spillway crest) (1,010 top of flashboards).

Upstream Portal Invert Outlet Conduit ≈ 973.5.

Downstream Portal Invert Outlet Conduit - 973.

Streambed at Centerline of Dam ≈ 970.

Maximum Tailwater - Not known.

d. Reservoir Length (miles).

Maximum Pool ≈ 19 (elevation 1020, top of dam).

Normal Pool ≈ 16 (elevation 1008, ogee spillway crest).

e. Reservoir Storage (acre-feet).

Spillway Crest ≈ 188,000 (elevation 1,008).

Top of Flashboards ≈ 217,000 (elevation 1,010).

Top of Dam ≈ 445,000 (elevation 1,020).

Design Surcharge - Not known.

f. Reservoir Surface (acres).

Spillway Crest - 14,528 (elevation 1008).

Top of Dam ≈ 21,000.

Maximum Design Pool - Not known.

g. Dam.

Type - Earth.
Length of Embankment - 1,500 feet (elevation 1,008).

Length, Including Road and Spillway - 2,400 feet.

Height - 50 feet.

Top Width - 32 feet.

Side Slopes -	Upper Upstream	2.5H:1V
	Middle Upstream	3H:1V
	Lower Upstream	2H:1V
	Upper Downstream	2.5H:1V
	Middle Downstream	3H:1V
	Lower Downstream	3H:1V

Zoning - Available drawings indicate the embankment is composed of either rolled or semi-hydraulic fill. Hand placed riprap covers the upstream slope between elevations 995 and 1016. A coarse gravel drain is located at the toe of the dam (see Figure 3)in the valley where the embankment height is greatest.

Impervious Core - (see Figure 3).

Cutoff - Available drawings indicate a cutoff trench was excavated along the centerline of the dam and backfilled with impervious material. Beyond the trench, steel sheetpiling was apparently driven to rock beneath that portion of the dam to the west of the original Shenango River Channel. To the east of the original Shenango River channel, sheetpiling was driven to depth of approximately 60 feet (not to the top of rock), as shown in Figure 3. Upstream of the sheetpiling in this area, a rolled fill impervious blanket was placed for a distance of approximately 800 feet in an apparent attempt to reduce the seepage losses beaneath the dam in this area. (see Figure 2)

Grout Curtain - None indicated.

h. Outlet Conduit.

Type - Two 6 feet by 8 feet rectangular box conduits constructed of reinforced concrete.

Length ≈ 250 feet.

Closure - Four sluice gates located at the gate house.

Access - Intake is submerged. Gate controls are located within the gate house.

Regulating Facilities - Discharge is controlled via four gate valves which operate 2-1/2 by 4 feet sluice gates.

i. Spillway.

Type - A concrete ogee-shaped weir at the spillway entrance discharges into a rubble masonry-lined channel located at the right abutment.

Spillway Crest - 1008 feet (1010 top of flashboards).

Weir Length - 114 feet.

Channel Length ≈ 480 feet.

Upstream Channel - Curved channel lined with hand placed riprap (see Photograph 9).

Downstream Channel - Shenango River Channel.

j. Regulating Facilities - The drawings indicate and a field check substantiated the presence of four sluice gate controls on the first floor of the gate house. The gates control flow through two 6- by 8-foot concrete culverts founded on rock which pass beneath the dam and discharge to the right of center of the dam.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. No engineering data were available concerning hydraulics and hydrology.

2. Embankment. Design drawings (pre-construction) are available from the PennDER files. The contract proposal and specifications were also provided by the Bureau of State Parks in Harrisburg, Pennsylvania.

3. Appurtenant Structures. Same as 2 (above).

b. Design Features. Pre-construction drawings and other files indicate that the dam is a zoned earth embankment. Portions of the embankment and an upstream impervious blanket were constructed of rolled earth as shown on Figure 3. It is not known, however, if the main portion of the embankment was constructed of rolled fill or semi-hydraulic fill. In any case, the specifications state that "the outer portion of the dam shall be composed of coarse material which shall be permanently stable under a condition of complete saturation. The center portion of the dam shall be composed of material containing sufficient clay or other finely divided particles to be highly impervious to water".

Interlocking sheetpiling was reportedly driven to rock, within a cutoff trench, west of old Shenango River channel. To the east, the sheetpiling was driven to an average depth of 60 feet and an impervious blanket was provided upstream of the dam in an attempt to reduce seepage losses in this area (see Figure 2).

The downstream slope of Pymatuning Dam is grass covered. Slopes are 2.5H to 1V between elevations 1002 and 1020 and are 3H to 1V below elevation 1002. Two ten-foot wide berms are located at elevations 1002 and 984 on the downstream dam face. The upstream slope is riprap covered between elevations 995 and 1016. Details of the upstream slope are shown on Figure 3.

The crest of the embankment is protected by masonry guardrails and an asphalt roadway which serves as an access road to park facilities.

2. Appurtenant Structures.

a) Spillway. The Pymatuning Reservoir spillway is a concrete and masonry structure with an ogee-shaped crest located at the right abutment (see Figures 3 and 4 and Photographs 8 and 9).

Available pre-construction drawings indicate that the structure is founded on rock and has a cutoff wall on each end.

b) Outlet Works. Controlled release from the reservoir is discharged through two 6-foot by 8-foot rectangular concrete conduits. Flow is controlled within the gate house located to the right of dam center (see Photographs 2 and 4) via four sluice gates measuring 2-1/2 feet wide by 4 feet high.

2.2 Construction Records.

No construction records are available.

2.3 Operational Records.

Hydrological reports detailing rainfall, pool level, and discharge are available at the park office.

2.4 Other Investigations.

Monthly inspection reports are available from PennDER files for the period 1960 to 1973. Additional reports were filed in 1940 and 1948, 1974, 1975 and 1976. These reports are available from PennDER and the Bureau of State Parks.

2.5 Evaluation.

Sufficient data are available to make a general assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. The general appearance of the structure and related appurtenances suggest that the facility is in fair condition.

b. Embankment. The pre-construction drawings indicate that the facility was to be constructed of rolled earth or a combination of rolled and semi-hydraulic fill. As-built drawings are not available; however, the surficial appearance of the dam indicates that it was constructed to the lines and grades shown on the contract drawings.

A swampy area is located beyond the toe of the dam over the left portion of the downstream valley (see Photographs 1 and 3). The swamp is situated at the approximate location of the old Shenango River channel as shown on Figure 2 and affects a triangular surface area with a base (along the toe of the dam) of about 500 feet and a depth (measured perpendicular to the base toward the stream channel) of 300 feet. Flow from the swamp is directed via a partially obstructed drainage ditch into the Shenango River just downstream of a gaging station (U.S.G.S. gaging station 300 feet downstream of dam) on the Shenango River outlet channel. Total discharge at this point on the day of inspection was estimated to be less than 5 gpm.

The swamp-like conditions at the toe have existed since the earliest inspection report was filed in 1940. An October 15, 1976, report from the Divison of Water Resources Projects, Bureau of Resources, also mentions the problem and attributes it to the phreatic surface in the embankment. The report goes on to say that "in some localized areas, a part of the seepage also appears through the foundation, which could be attributed either to sheet pile crevices or poor contact with the rock bottom". The report concludes that the "marshy and sloughy conditions should be considered as unsafe and adequate protective measures should be provided for the safety of the structure."

No seepage flow could be measured at the downstream toe at the time of inspection. As previously mentioned, however; some flow was discharging into the Shenango River on the downstream side of the swamp.

Pymatuning Dam is reportedly provided with a coarse gravel toe and blind drain below the berm at elevation 984. It is conceivable that the blind drain discharges at the location of the swamp and that the marshy condition results

from poor drainage at this point. It is also possible that some seepage is passing beneath the dam through the glacial soils in the area east of the old Shenango River channel in the area where sheetpiling was not driven to rock.

Another area of seepage was noted to the right (west) of the discharge end of the primary outlet structure (see Photographs 5 and 6). The seepage is passing through in-place soil and is partially diverted via two clay pipe drains which discharge onto the concrete walkway below. Total flow was minimal (could not be measured) and the condition is not considered serious under present conditions.

The downstream face of the dam is provided with a number of slope gutters which direct flow from the roadway (crest) and downstream face to the toe of the dam. When initially constructed, the drains were cobble gutters; however, in more recent years, they have been mantled with concrete (for details of gutter paving, see Figures 1 and 7).

Numerous rodent holes were also noted on the downstream face of the dam.

c. Appurtenant Structures.

1. Spillway. The spillway, spillway sidewalls, apron, and plunge pool all appeared in good condition. Some fine scaling was observed on the ogee-crested weir, the spillway apron, and bridge piers; however, the condition is not considered serious.

Reportedly the spillway has never discharged. Some time after construction, 2 feet high flashboards were added to the ogee section in order to secure additional flood storage capacity (see Photographs 8 and 9). Section 17 of the Maintenance and Operations Manual for the facility states that the flashboards are so constructed that they will fail when they are overtopped by several feet of water.

Water discharging through the spillway is directed into a stilling basin and finally into the downstream Shenango River drainage as shown on Figure 2 and Photograph 11.

2. Primary Outlet Works. The primary outlet works at Pymatuning Reservior consist of two 6-foot by 8-foot rectangular concrete conduits as shown on Figure 6. Flow through the conduits is regulated via four sluice gates measuring 2-1/2 feet wide by 4 feet high, controlled from the operating room of the gate house (see Figure 11). Stop logs can be placed on the upstream side of the gate chamber

thereby allowing access to the outlet conduit and gate controls. Stop logs had been installed in one of the outlets and this outlet was inspected.

The 6- by 8-foot outlet conduit was in good condition aside from some scaling near the inlet (see Photograph 7). The gate control stems and sluice gate were badly corroded and are reported to be inoperative. According to the park superintendent, a contract to replace the stems, stem guides, stem thrust bolt, and to sandblast and paint the sluice gates has been let and this work is scheduled for the near future.

Recommendations to perform this work can be found in a letter to Mr. Forrey (Director, Bureau of State Parks) as early as 1974. Similar recommendations were made again in 1976.

3. Reservoir Area. The slopes adjoining Pymatuning Reservoir are gentle and partially wooded. No indications of slope distress were observed at the time of inspection.

4. Downstream Channel. The area immediately downstream of Pymatuning Reservoir is characterized as a broad (2,000-foot wide) partially wooded floodplain containing numerous dwellings. The outskirts of the community of Jamestown, Pennsylvania, are located approximately 3,000 feet downstream of the dam. The borough of Greenville is located about 7 miles downstream of the dam. Part of the business center as well as numerous industrial establishments are located adjacent to the river at this point. Suffice to say that a failure of Pymatuning Dam would have a devastating effect on both life and property downstream, possibly effecting hundreds of persons.

Because of the above mentioned considerations, the hazard catagory is considered "high".

3.2 Evaluation.

The outlet works are in need of remedial repair. Some seepage requiring further evaluation was noted at the downstream toe. The seepage has created swampy conditions near the left abutment. This area should be provided with positive drainage and the flow recorded.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operational Procedures.

An operations manual has been prepared and is used at the facility. The manual lists normal operational procedures as well as flood emergency operation procedures. There are also provisions for normal maintenance and inspection.

4.2 Maintenance of the Dam.

The manual lists procedures for inspecting and maintaining the dam including mowing and clearing the dam face, maintaining the slope gutters, and exterminating all burrowing animals.

4.3 Maintenance of Operating Facilities.

The manual also contains procedures for inspecting and maintaining the operating facilities. Operating stems are to be kept lubricated and sluice gates painted to prevent corrosion. It is obvious from the present condition of the gates and stems that maintenance has not been thoroughly provided over the years although a certain amount of corrosion should probably be expected on mechanical systems of this age.

4.4 Warning Systems.

There are no formal warning systems in effect at the site; however, the park superintendent and the park hydraulic engineer are familiar with the operation of the facility and are available on a full-time basis.

4.5 Evaluation.

Periodic inspection reports have been prepared on the facility throughout its history. Maintenance is reportedly provided for the dam and its appurtenances. Although no maintenance reports are available, the Bureau of State Parks is in the process of replacing and repairing portions of the controls on the outlet system.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No hydrologic or hydraulic data are available.

5.2 Experience Data.

Daily rainfall and reservoir level records are compiled at the facility and kept on file at the Bureau of State Parks offices in Harrisburg, Pennsylvania. The general appearance of the facility indicates adequate past performance. A U.S.G.S. gaging station is located approximately 550 feet downstream of the dam on the Shenango River channel. Hydrometeorological data from this facility is tabulated by the U. S. Weather Bureau.

5.3 Visual Observations.

On the date of the inspection, the general condition of the appurtenant structures of the dam indicate that the facility would likely operate satisfactorily during a flood event. One probable exception to this is the right outlet conduit. Two inoperable gates associated with this conduit make flow regulation impossible. These gates are scheduled for replacement in the near future.

5.4 Overtopping Potential.

The ratio "PMF Peak Flow/Drainage Area" was determined from an empirical curve supplied by the Corps of Engineers, Baltimore District. The curve used was the Ohio River Basin curve. Based on this curve and a drainage area of 158 square miles, Peak PMF Q/A = 540 cfs/sq. mi., and Peak PMF Q = 85,320 cfs. The size category is "large" and the hazard rating "high". Consequently, the SDF is the PMF.

Calculations (see Appendix C) were performed to evaluate the overtopping potential using spillway and storage capacities during the PMF.

The emergency spillway has a maximum discharge capacity of approximately 17,150 cfs assuming that the flashboards atop the spillway crest fail under several feet of head as stated in the Operations and Maintenance Manual. A comparison of maximum spillway discharge (17,150 cfs) with Peak PMF Q

(85,320 cfs) indicates a need for a significant volume of available storage. Based on normal pool elevation 1008 and top of dam elevation 1020, the available storage at Pymatuning Reservoir is calculated to equal approximately 228,000 acre-feet which is greater than the computed storage volume required of 175,000 acre-feet. In fact additional calculations based on storage volume alone indicate that the total inflow to the reservoir during a storm with 26 inches of run-off would be 219,000 acre-feet which is less than the available storage of 228,000 acre-feet. Consequently, it is concluded that the dam is not likely to be overtopped when subjected to a storm of PMF magnitude.

5.5 Spillway Adequacy.

The dam at Pymatuning Reservoir is able to pass and/or contain the inflow resulting from a storm of PMF intensity. As a result, the spillway is deemed adequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the dam appeared to be in fair condition. A small amount of seepage was observed issuing from two seeps located on the natural hillside to the right of the 6-foot by 8-foot outlet conduits. This condition was not considered serious since flow was minimal and it is possible that it is associated with the drains which appear to be draining the parking lot area on the crest of the embankment between the outlet conduits and the emergency spillway (see Figure 2).

A swampy area is present at the toe of the embankment near the left abutment at the location of the old Shenango River channel. The swampy condition is reported in inspection reports as early as 1940. At the time of inspection, there was no indication of seepage emanating above the toe of the embankment and the condition may simply be the result of poor drainage conditions at the downstream toe. The dam is reportedly provided with a coarse gravel toe and a blind drain; however, the available drawings do not indicate where the drain discharges. A partially obstructed drainage ditch was found just left of the swamp. A small amount of discharge passes through the ditch and enters the Shenango River.

b. Appurtenant Structures.

1. Spillway. The spillway appeared to be in good condition. It appeared that some of the flashboards atop the ogee crest had recently been replaced.

2. Outlet Works. According to available PennDER files, the sluice gate controls which regulate flow through the 6- by 8-foot outlet conduits are in a deteriorated condition. Stop logs had been installed in the right outlet conduit in preparation for repairing the outlet controls. Consequently, we were able to directly observe their corroded condition. Considerable scaling was also observed on the walls of the outlet conduit just downstream of the sluice gates (see Photograph 7).

The gate house and the crane that is used to install the stop logs appeared in good condition.

6.2 Design and Construction Techniques.

Actual design data, design computations, or reports

were not available for any aspect of the facility. It is not known whether the structure was constructed entirely of rolled earth or a combination of rolled earth and semi-hydraulic fill.

6.3 Past Performance.

There is no indication that the emergency spillway located on the right abutment has ever discharged. Rainfall records and weir readings taken both upstream and downstream of the dam are available from PennDER files. The facility has apparently functioned well since construction.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and may, therefore, be subjected to minor seismic forces. Considering the swampy area at the toe, the possibility of the embankment being constructed of hydraulic fill and the uncertainty surrounding the engineering properties of the foundation materials, it is possible that even minor dynamic forces could be significant, particularly at high pool levels. However, no design analyses or seismic calculations were made to support this belief.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection, operational history, and available engineering data suggest that the dam is in fair condition. However, the controls for the primary outlet works are in a deteriorated condition and the sluice gates on the right outlet portal are inoperable.

Since the primary purpose of Pymatuning Reservoir is for the conservation of waters entering Pymatuning Swamp and for regulating the flow of water in the Shenango and Beaver Rivers, it is imperative that the primary outlet works at the facility function properly. From a safety standpoint, the problem is less serious considering that the project can store the runoff associated with a storm of PMF magnitude therefore, the spillway system is considered adequate.

According to Bureau of State Parks personnel, they are planning to replace the controls for the outlet works in the near future.

Two areas of seepage were found associated with the embankment. The first was noted to the right of the discharge end of the primary outlet structure (see Photographs 5 and 6). Seepage in this area was minimal and may be associated with tile drains which apparently drain the parking area atop the dam (see Figure 2).

The second was the swampy area at the toe of the dam. The dam is apparently provided with a coarse gravel toe and a blind drain. We were not able to ascertain the location of an outlet for the blind drain and it may be that the swampy condition at the toe persists because of poor drainage conditions or because seepage is passing beneath the sheet-piling in the area of the left abutment where the piling was not driven to rock. In any event the situation requires further evaluation.

b. Adequacy of Information. The data available was considered sufficient to make a Phase I assessment of the facility.

c. Urgency. It is suggested that the recommendations listed below be implemented immediately.

d. Necessity for Additional Investigations. No additional investigations are considered necessary at this time except as noted in Section 7.2.

7.2 Recommendations/Remedial Measures.

It is recommended that:

a. The outlet works be thoroughly evaluated and repairs made which will ensure the operability of the system. Note: According to State Parks personnel, they are in the process of letting a contract to make the necessary reparations.

b. The deteriorated concrete within the primary outlet conduits be repaired.

c. The swampy area at the toe of the dam be drained. A weir or weirs should be installed to monitor flow in the region. This information should be transmitted to the Division of Water Resources Projects, Bureau of Resources Programming within the PennDER for their review. The results of the weir readings and the relationship with pool level, rainfall, and seasonal variations should be evaluated by a registered engineer experienced in the design and construction of earth dams. Further investigations, including the installation of observation wells, may be necessary if the seepage is deemed excessive or if abnormal conditions are indicated.

d. The rodents residing on the downstream face should be exterminated and their burrows filled.

e. A warning system be developed to allow for the safe evacuation of downstream residents in the event that emergency conditions develop. This plan could easily be incorporated into the "Operations and Maintenance Manual" currently in use.

f. The dam be inspected on an annual basis to check for hazardous conditions which might develop.

APPENDIX A

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

DAM NAME Pymatuning Reservoir COUNTY Crawford STATE Pennsylvania NDI# PA-176 ID # PennDER 20-7

TYPE OF DAM Earth HAZARD CATEGORY High

DATE(S) INSPECTION July 28, 1978 WEATHER Partly cloudy TEMPERATURE 75°

POOL ELEVATION AT TIME OF INSPECTION 1007.56 M.S.L. TAILWATER AT TIME OF INSPECTION - M.S.L.

INSPECTION PERSONNEL:

B. M. Mihalcin (GAI)	Bureau of State Parks
J. P. Nairn (GAI)	Bud Hetrick - Park Superintendent
D. L. Bonk (GAI)	Sam Pusateri - Engineer/Hydrologist

B. M. Mihalcin RECORDER

EMBANKMENT ID# PA-176 Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good.	
RIPRAP FAILURES	None observed. The riprap appears to be a very durable sandstone.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition	
ANY NOTICEABLE SEEPAGE	Two small areas of seepage are visible located on the hillside just downstream and to the right of the discharge end of the outlet conduit. The general location of this seepage is approximately 18 feet above the streambed or 10 feet above the top of the concrete wingwall. In addition to these two areas, there is a broad saturated zone located at the toe of the left side of the embankment. This zone is approximately 500 feet wide at the base of the toe but narrows as it extends downstream toward the river.	
STAFF GAGE AND RECORDER		
DRAINS	Conctete covered masonry gutters divert surface drainage from the downstream face.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Minor cracking and deterioration are visible on concrete surfaces. These small isolated areas are not considered to be significant.	
INTAKE STRUCTURE	Stone masonry gate house located approximately 1,400 feet from the left abutment contains the outlet conduit intakes. Two intakes are regulated by 4 sluice gates and a series of wood stop logs.	
OUTLET STRUCTURE	Two parallel concrete box culverts, 6 feet wide by 8 feet high, carry flow from the gate house approximately 300 feet through the embankment to the point of discharge located approximately 1,400 feet from the left abutment. A close inspection of the interior of the conduit reveals moderate scaling across a majority of the interior surface. This condition coupled with minor efflorescence is most prevalent in the upstream 75 feet of the horizontal outlet conduits.	
OUTLET CHANNEL	Curved channel in apparent good condition. Both the left and right embankments are lined with hand-placed riprap for the first few hundred feet. The channel carries discharge from right to left approximately 250 feet downstream of the toe. At a point approximately 900 feet from the discharge end of the outlet conduit is located a concrete weir which can monitor discharge.	
EMERGENCY GATE	Located at the gate house. Reportedly two of the gates are not operable because of corrosion of the gate stems. However, the park superintendent indicated that the gates are scheduled to be replaced in the very near future.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	An ogee-shaped concrete weir is located at the entrance to the emergency spillway. Atop the weir are located 2 feet of wooden flashboards.	
APPROACH CHANNEL	Curved channel lined with hand-placed riprap extends from the gate house to the spillway located at the right abutment. The channel appears to be in good condition.	
DISCHARGE CHANNEL	Masonry-lined channel just downstream of the weir which discharges into a stilling basin. Flow is then directed into the old Sugar Run channel before converging with the flow from the gated outlet works.	
BRIDGE AND PIERS	Two concrete piers support a bridge which spans the spillway discharge channel. These piers are located immediately downstream of ogee-shaped concrete weir. The bridge serves to connect the west reservoir shore with the roadway situated atop the dam crest which leads to the east reservoir shore.	

ISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ONCRETE SILL	N/A.	
PPROACH CHANNEL	N/A.	
ISCHARGE CHANNEL	N/A.	
RIDGE AND PIERS	N/A.	
ATES AND OPERATION QUIPMENT	N/A.	

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	See "Outlet Channel, Outlet Works".	
PIEZOMETERS	None observed.	
OTHERS		

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The lake is a major recreational facility and has an extensively developed shoreline. The slopes are gentle for the most and only partially wooded. Much of the surrounding area is considered swampland.	
SEDIMENTATION	None observed.	

DOWNSTREAM CHANNEL ID # PA-176 SHEET 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is a gentle sloping broad floodplain. The first downstream obstruction a roadway bridge which crosses the Shenango River at distance approximately 2 miles downstream of the dam.	
SLOPES	Gentle.	
APPROXIMATE NO. OF HOMES AND POPULATION	Extensive development including portions of the communities of Jamestown and Greenville would undoubtedly be affected by a breach of the embankment. Population > 1,000.	

APPENDIX B

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Pymatuning Reservoir
NDI# PA-176
ID # PennDER# 20-7

EM	REMARKS	SHEET 1

-BUILT DRAWINGS

None available.

GIONAL VICINITY MAP

See Appendix G.

NSTRUCTION HISTORY

Partial history available from operating manual supplied by park superintendent.

'PICAL SECTIONS OF DAM

See Figure 3.

JTLETS - PLAN See Figures 5, 6, 7, 10, and 11.

- DETAILS See Figures 10 and 11.

- DISCHARGE RATINGS None available.

AINFALL/RESERVOIR RECORDS

Available at the park office or from the Bureau of State Parks in Harrisburg, Pennsylvania.

ITEM	REMARKS	ID # PA-176	SHEET 2

ESIGN REPORTS

None available.

EOLOGY REPORTS

None available.

ESIGN COMPUTATIONS
YDROLOGY & HYDRAULICS
AM STABILITY
EEPAGE STUDIES

None available.

ATERIALS INVESTIGATIONS
ORING RECORDS
ABORATORY
IELD

Boring records available from PennDER files.

OST-CONSTRUCTION SURVEYS OF DAM

None available.

ORROW SOURCES

Not known.

MONITORING SYSTEMS

None.

MODIFICATIONS

Crane added to gate house to mechanically place stop logs.

HIGH POOL RECORDS

None available.

POST CONSTRUCTION ENGINEERING
STUDIES AND REPORTS

Numerous inspection reports available from PennDER files.

PRIOR ACCIDENTS OR FAILURE OF DAM
DESCRIPTION
REPORTS

None.

MAINTENANCE
OPERATION
RECORDS

None available.

ITEM	REMARKS	ID # PA-176	SHEET 4

SPILLWAY PLAN See Figures 4 and 9.

SECTIONS See Figures 4 and 9.

DETAILS See Figures 4 and 9.

OPERATING EQUIPMENT
PLANS & DETAILS See Figures 10 and 11.

NDI# PA-176

CHECK LIST ID # PennDER# 20-7

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 158 sq. miles.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1008 feet (188,000 acre-feet).

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1010 feet (217,000 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: Not known.

ELEVATION TOP DAM: 1020.

SPILLWAY DATA:

a. Crest Elevation 1008; 1010 (top of flashboards).
b. Type ogee crest.
c. Weir Length 114 feet.
d. Channel Length ≃ 480 feet.
e. Location Spillover right abutment. (445,000 acre-feet)
f. Number and Type of Gates none.

OUTLET WORKS:

a. Type Rectangular concrete box culverts.
b. Location 1,400 feet right of left abutment.
c. Entrance Inverts ≃ 973.5.
d. Exit Inverts 973.
e. Emergency Draindown Facilities Four sluice gates 2-1/2 by 4 feet controlling flow through two 6 by 8 feet concrete culverts.

HYDROMETEOROLOGICAL GAGES:

a. Type Rain gage.
b. Location Pymatuning park office.
c. Records at park office.

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX C

HYDROLOGY AND HYDRAULIC CALCULATIONS

SUBJECT DAM SAFETY INSPECTION
PYMATUNING RESERVOIR

BY DLR DATE 7-8-78 PROJ. NO. 78-501-176

CHKD. BY EJM DATE 8-25-78 SHEET NO. 1 OF 6

CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

DAM STATISTICS

MAXIMUM HEIGHT OF DAM = 50 FEET (REF 1; pg 3)

DRAINAGE AREA = 158 sq. mi. " "

STORAGE CAPACITY ≃ 217,000 AC-FT @ EL 1010 (REF 1; pg 4)
≃ 188,000 AC-FT @ EL 1008 " "

SIZE CLASSIFICATION

DAM SIZE - LARGE (REF 2; TABLE 1)

HAZARD RATING - HIGH (POSSIBLE LOSS OF LIFE > 3)

REQUIRED SDF = PMF (REF 2; TABLE 3)

REFERENCES

1 : "OPERATION AND MAINTENANCE MANUAL FOR PYMATUNING RESERVOIR"
AVAILABLE AT THE PARK OFFICE

2 : "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS"
DEPT. OF THE ARMY - OFFICE OF CHEIF ENGINEER, APPENDIX D

3 : STANDARD HANDBOOK FOR CIVIL ENGINEERS
F.S. MERRITT, McGRAW-HILL 1976

SUBJECT DAM SAFETY INSPECTION
PYMATUNING RESERVOIR

BY DLB DATE 8-7-78 PROJ. NO. 78-501-176

CHKD. BY EJM DATE 8-25-78 SHEET NO. 2 OF 6

gai CONSULTANTS, INC.
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PMF (PEAK FLOW)/AREA = 540 CFS/SQ.MI. (REF: C OF E CURVE, OHIO RIVER BASIN)

PMF = (540 CFS/SQ.MI.)(158 SQ.MI.) = 85,320 CFS

TOTAL TIME OF FLOW = 100 HRS (REF: C OF E CURVE, OHIO RIVER BASIN)

VOLUME OF INFLOW HYDROGRAPH

$V = \frac{1}{2}(Q_{IMAX})(TIME)$

$= \frac{1}{2}(85,320\ CFS)(100\ HRS)(3600\ SEC/HR)(1\ ACRE/43,560\ SQ.FT.)$

$= 352,562$ AC-FT

DETERMINE THE AVERAGE RUNOFF REQUIRED TO PRODUCE THE ABOVE VOLUME OF INFLOW.

$(352,562\ AC\text{-}FT)(1\ SQ.MI./640\ ACRES)(12\ IN/FT)/(158\ SQ.MI.) = 41.8$ INCHES

VOLUMES PRODUCED BY RUNOFF IN EXCESS OF 26 INCHES ARE TO BE RECALCULATED USING 26 INCHES AS AN UPPER BOUND.

$(26\ INCHES)(158\ SQ.MI.)(640\ ACRES/SQ.MI.)(1\ FT/12\ IN.) = 219,093$ AC-FT

VOLUME OF INFLOW = 219,093 AC-FT

NOTE: Q_{IMAX} REMAINS CONSTANT
TOTAL TIME OF FLOW DECREASES IN ACCORDANCE WITH THE DECREASE IN INFLOW VOLUME

EQUIVALENT FLOW TIME $= [(219,093\ AC\text{-}FT)(2)(43,560\ FT^2/AC)]/(85,320\ CFS)(3600\ SEC/HR)$
$= 62.1$ HRS

SUBJECT DAM SAFETY INSPECTION
PYMATUNING RESERVOIR

BY DLB DATE 9-8-78 PROJ. NO. 78-501-176

CHKD. BY JPN DATE 9-8-78 SHEET NO. 3 OF 6

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CALCULATE AVAILABLE STORAGE

RESERVOIR SURFACE @ NORMAL POOL (EL 1008) ≃ 14,528 ACRES
(REF 1; pg 3 & 4)

RESERVOIR SURFACE @ TOP OF DAM (EL 1020) ≃ 23,470 ACRES
(PLANIMETERED FROM U.S.G.S. 7.5 MINUTE QUADRANGLES)

AVAILABLE FREEBOARD = 12 FEET

STORAGE AVAILABLE ≃ $(12\text{Ft})[(23{,}470 + 14{,}528)\text{ACRES}/2] =$

$= 227{,}988\ \text{AC-FT}$

STORAGE AVAILABLE (227,988 AC-FT) > INFLOW VOLUME (219,093 AC-FT)

SUBJECT DAM SAFETY INSPECTION
PYMATUNING RESERVOIR

BY DLB DATE 8-7-78 PROJ. NO. 78-501-176

CHKD. BY EJM DATE 8-25-78 SHEET NO. 4 OF 6

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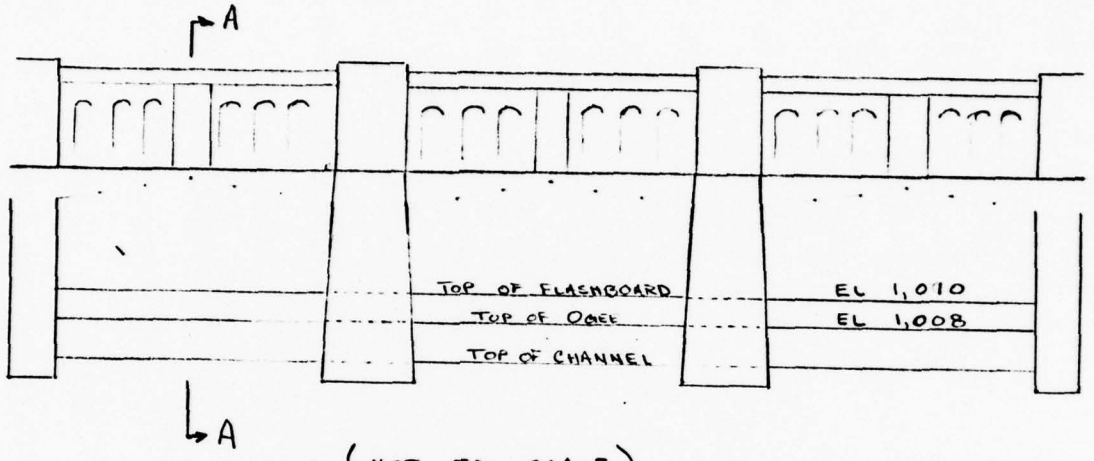
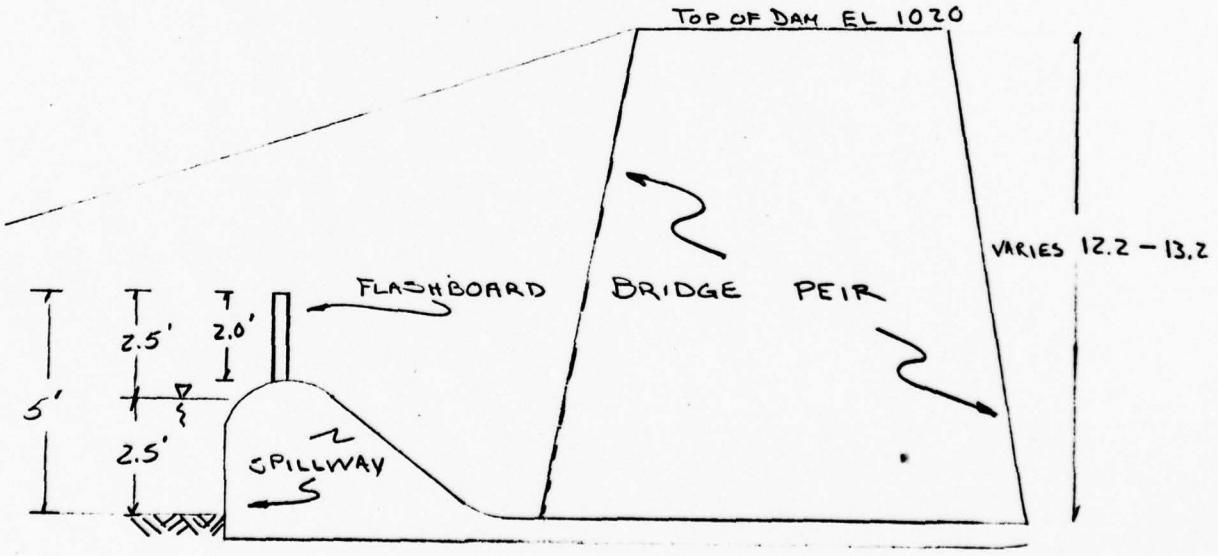


(NOT TO SCALE)



SECTION A-A (NOT TO SCALE)

NOTE:
ALL ELEVATIONS ARE TAKEN FROM REFERENCE 1, PAGE 3.
ALL DIMENSIONS ARE TAKEN FROM FIELD NOTES

SUBJECT DAM SAFETY INSPECTION
PYMATUNING RESERVOIR

BY DLB DATE 8-7-78 PROJ. NO. 78-501-17

CHKD. BY EJM DATE 8-25-78 SHEET NO. 5 OF 6

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SPILLWAY CAPACITY

$Q = C L H^{3/2}$ (REF 3: EQ 21-121)

Q = CAPACITY OF WEIR

L = LENGTH OF WEIR = 114' (REF: FIGURE 9, APPEDIX F)

H = MAXIMUM DISCHARGE HEAD = 12' (REF 1, PG 3; DIFFERENCE IN ELEVATION BETWEEN TOP OF DAM AND TOP OF SPILLWAY CREST)

C = COEFFICIENT OF DISCHARGE

$P/H_D = 3/12 = 0.25$

$\therefore \quad C = 3.62$ (REF 3, FIG 21-67)

$Q = (3.62)(114')(12')^{3/2}$

$Q \simeq 17,155$ CFS

NOTE: IT IS ASSUMED THE FLASHBOARDS WILL FAIL UNDER HIGH HEADS

SUBJECT DAM SAFETY INSPECTION
PYMATUNING RESERVOIR

BY DLB DATE 8-7-78 PROJ. NO. 78-501-176

CHKD. BY EJM DATE 8-25-78 SHEET NO. 6 OF 6

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CONSIDER INFLOW RELATIVE TO BOTH OUTFLOW AND STORAGE USING THE SHORT CUT METHOD AS RECOMMENDED BY NAD.

$$P = \frac{\text{MAXIMUM SPILLWAY DISCHARGE}}{\text{PMF PEAK INFLOW}} = \frac{17,155 \text{ CFS (SHEET 4)}}{85,320 \text{ CFS (SHEET 2)}}$$

$P = 0.20$

$$(1-P) = \frac{\text{REQUIRED RESERVOIR STORAGE}}{\text{INFLOW VOLUME}} = 0.80$$

VOLUME OF INFLOW = 219,093 AC-FT

REQUIRED RESERVOIR STORAGE = (0.80 X 219,093 AC-FT) =

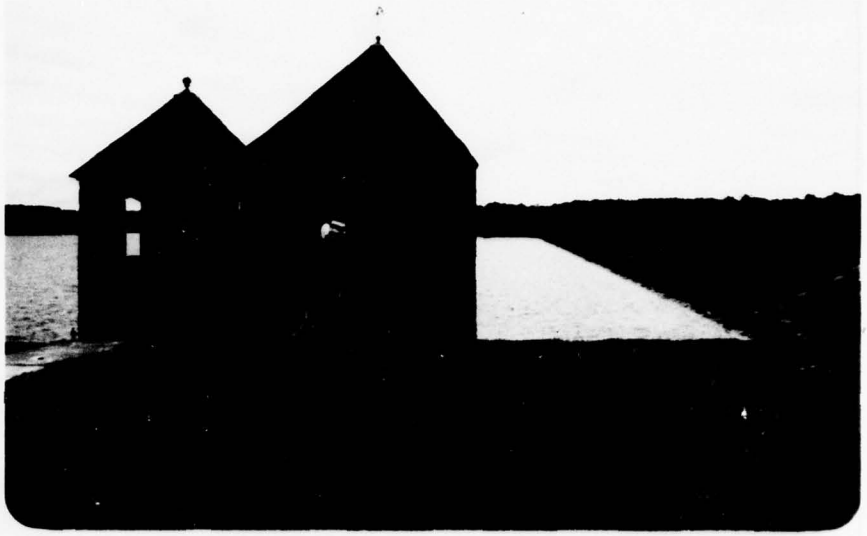
= 175,274 AC-FT

STORAGE AVAILABLE (227,988 AC-FT) > STORAGE REQUIRED (175,274 AC-FT)

APPENDIX D

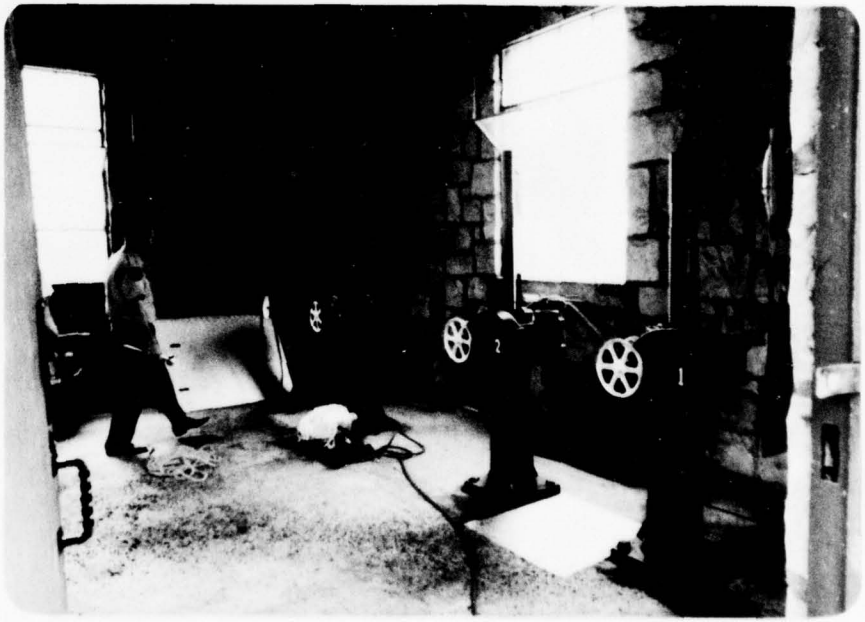
PHOTOGRAPHS

1



2

3



4

PHOTOGRAPH 5 View of the discharge end of the outlet works at Pymatuning Reservoir. Only one portal was discharging at the time of inspection. Note the seepage line in the left portion of the photograph (dark green areas near field team members).

PHOTOGRAPH 6 Close-up view of tile drains and seepage near the toe of the dam just to the right of the outlet works.

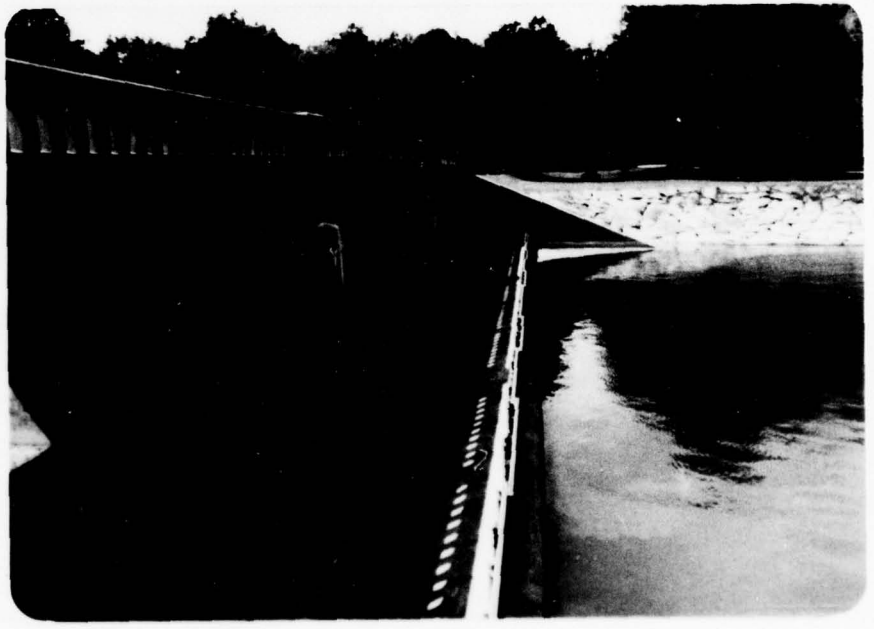
PHOTOGRAPH 7 Close-up view of scaling within the outlet portal just downstream of the service gates.

PHOTOGRAPH 8 View of the flashboards and ogee-crested spillway located in the right abutment.

5

6

7



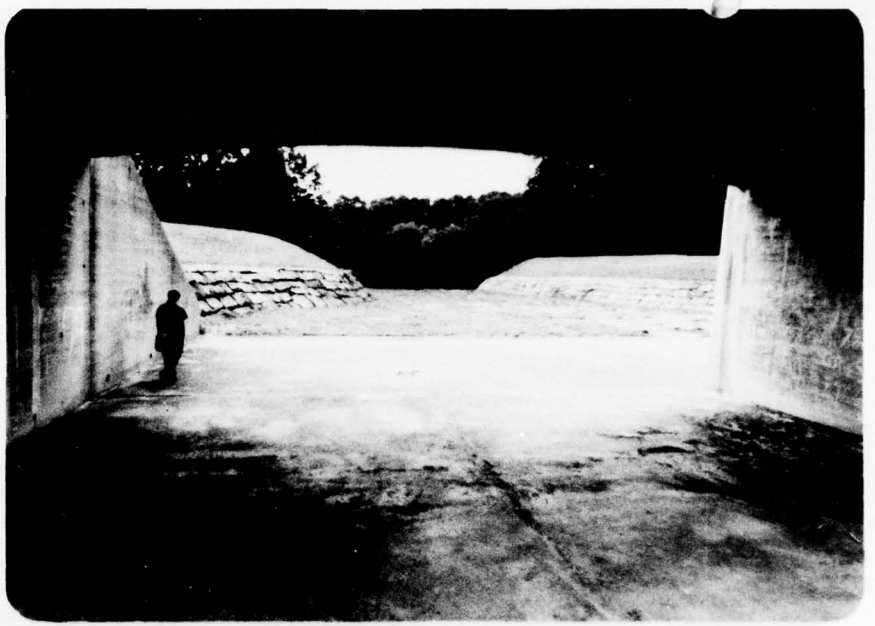
8

PHOTOGRAPH 9 View of the masonry-lined approach channel to the spillway.

PHOTOGRAPH 10 View of the spillway channel just downstream of the ogee-crested weir.

PHOTOGRAPH 11 View of the concrete weir located about 500 feet downstream of the Pymatuning spillway plunge pool.

9



10

11

APPENDIX E

GEOLOGY

The Pymatuning Reservoir Dam is located in the glaciated portion of the Appalachian Plateau Physiographic province of northwestern Pennsylvania. The western-most area of the reservoir extends into northeastern Ohio.

The glacial deposits surrounding the dam and reservoir are chiefly ground moraines of the Kent and Hiram Units of Wisconsin age. Also present are undifferentiated Kames and outwash deposits of various ice advances. Thicknesses of the glacial material are quite variable and are normally 20 to 40 feet but may approach 90 to 100 feet in some areas. The Kent moraine consists of loam to sandy loam till and sand and gravel. The Hiram moraine is chiefly silty clay. The Kame and outwash deposits consist largely of sand and gravel with minor amounts of interbedded silt and clay.

The rock strata underlying the glacial material is of Mississippian and Devonian age. The northern portion of the reservoir pool is underlain by the Devonian age Riceville Formation (Pennsylvania) and the Chagrin Formation (Ohio). The Riceville Formation is composed of interbedded shales, siltsones, and sandstone and the Chagrin is chiefly shale with sandstone interbeds. The southern portion of the reservoir and the dam are underlain by the Pocono Group (Pennsylvania) and Cussewago sandstone (Ohio). The Pocono strata is mostly massive sandstone with some shale.

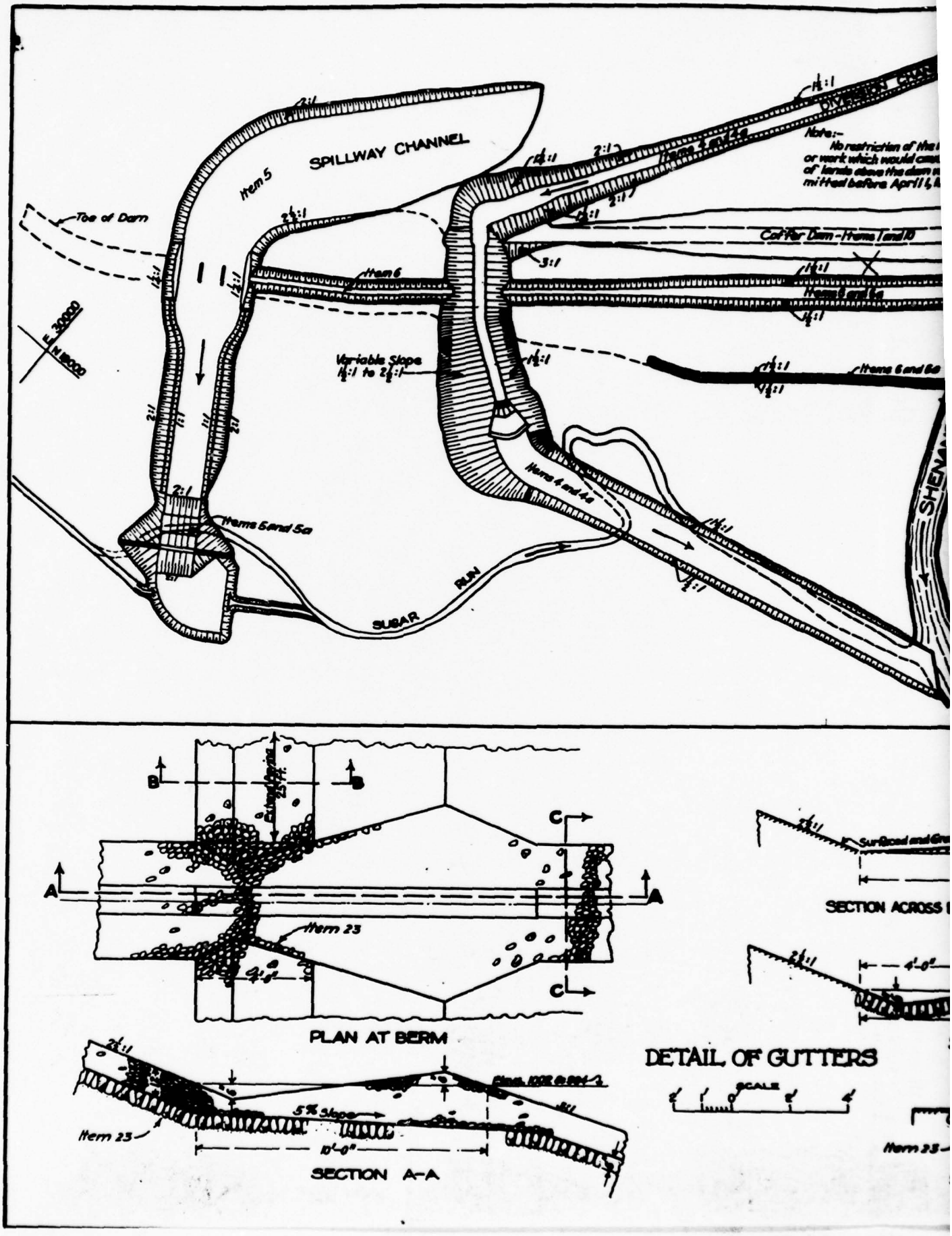
The structure of the rock strata is characterized by nearly horizontal bedding generally striking northeast and

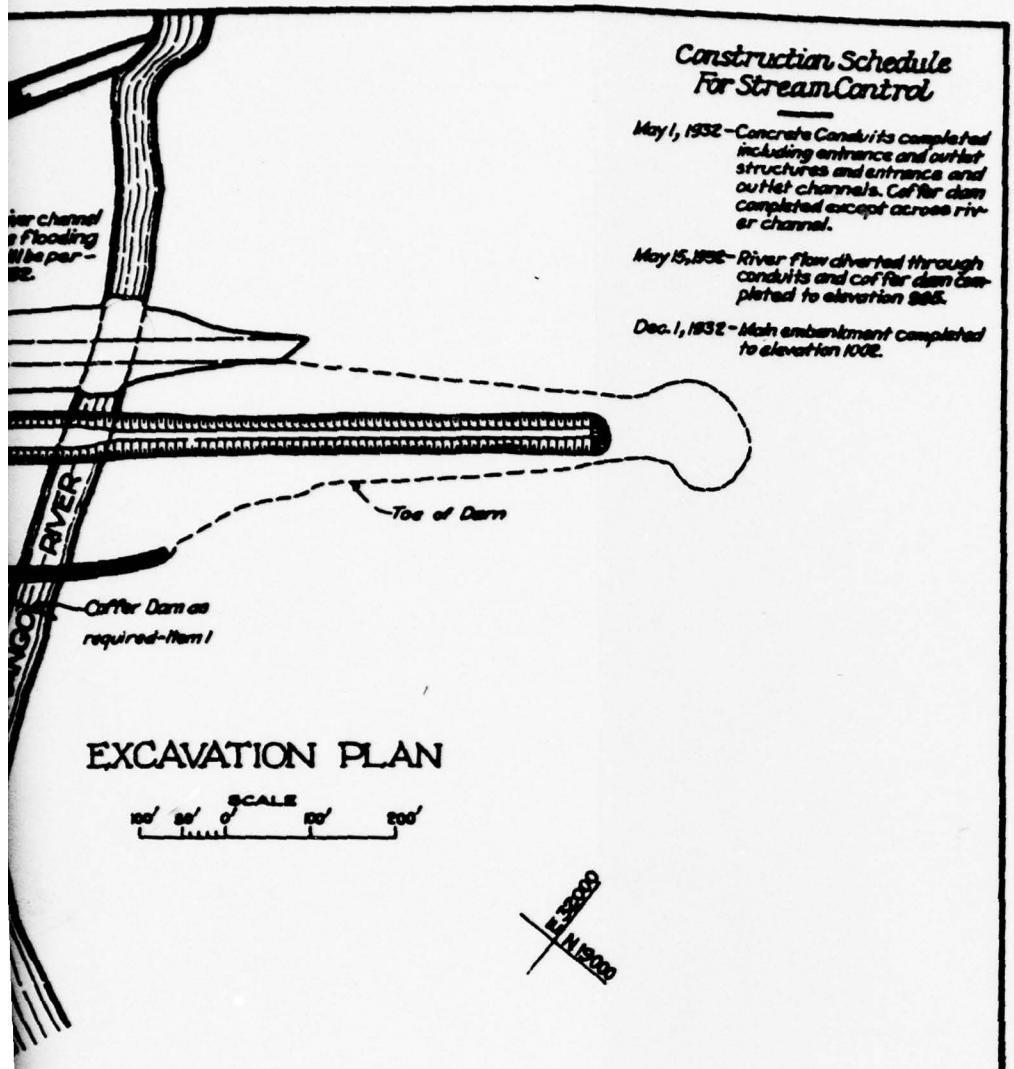
dipping gently to the south or southeast. Jointing within the reservoir area normally has two major sets occurring approximately at right angles. These sets trends N40E and N55W. The set which trends N40E is more prominant and in some of the more resistant sandy layers present structural control.

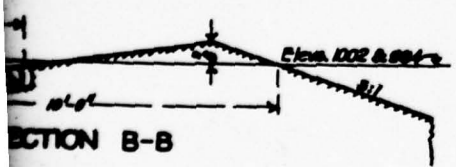
APPENDIX F

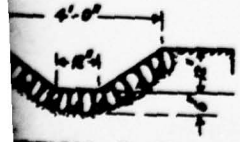
FIGURES

LIST OF FIGURES


SPILLWAY CHANNEL
Item 5
Toe of Dam
Item 6
Variable Slope
½:1 to 2½:1
Items 5 and 5a
Items 4 and 4a
Items 6 and 6a
Cofferdam - Items 7 and 10
SUSAR
RUN
Note:-
PLAN AT BERM
Item 23
5% Slope
10'-0"
SECTION A-A
DETAIL OF GUTTERS
SECTION ACROSS
4'-0"
SCALE



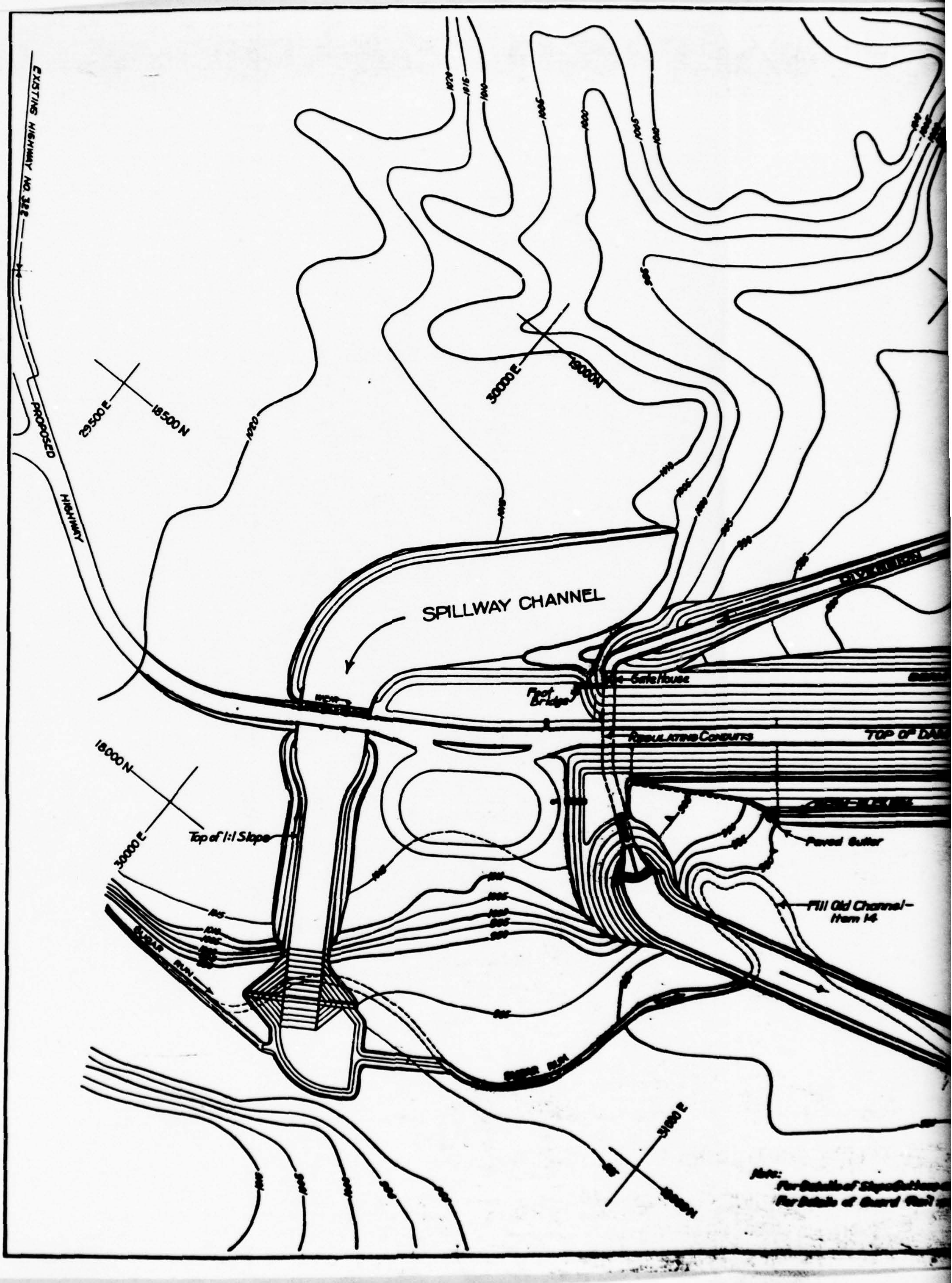




COMMONWEALTH OF PENNSYLVANIA
WATER AND POWER RESOURCES BOARD
PYMATUNING DAM
EXCAVATION PLAN
AND
DRAINAGE DETAILS
SCALES AS SHOWN
CONTRACT DRAWING NO. 6

FIGURE 1

2


EXISTING HIGHWAY NO. 328
PROPOSED HIGHWAY
29500 E
18500 N
30000 E
19000 N
SPILLWAY CHANNEL
Gate House
Foot Bridge
REGULATING CONDUITS
18000 N
30000 E
Top of 1:1 Slope
Paved Gutter
Fill Old Channel—
Item 14
Note:

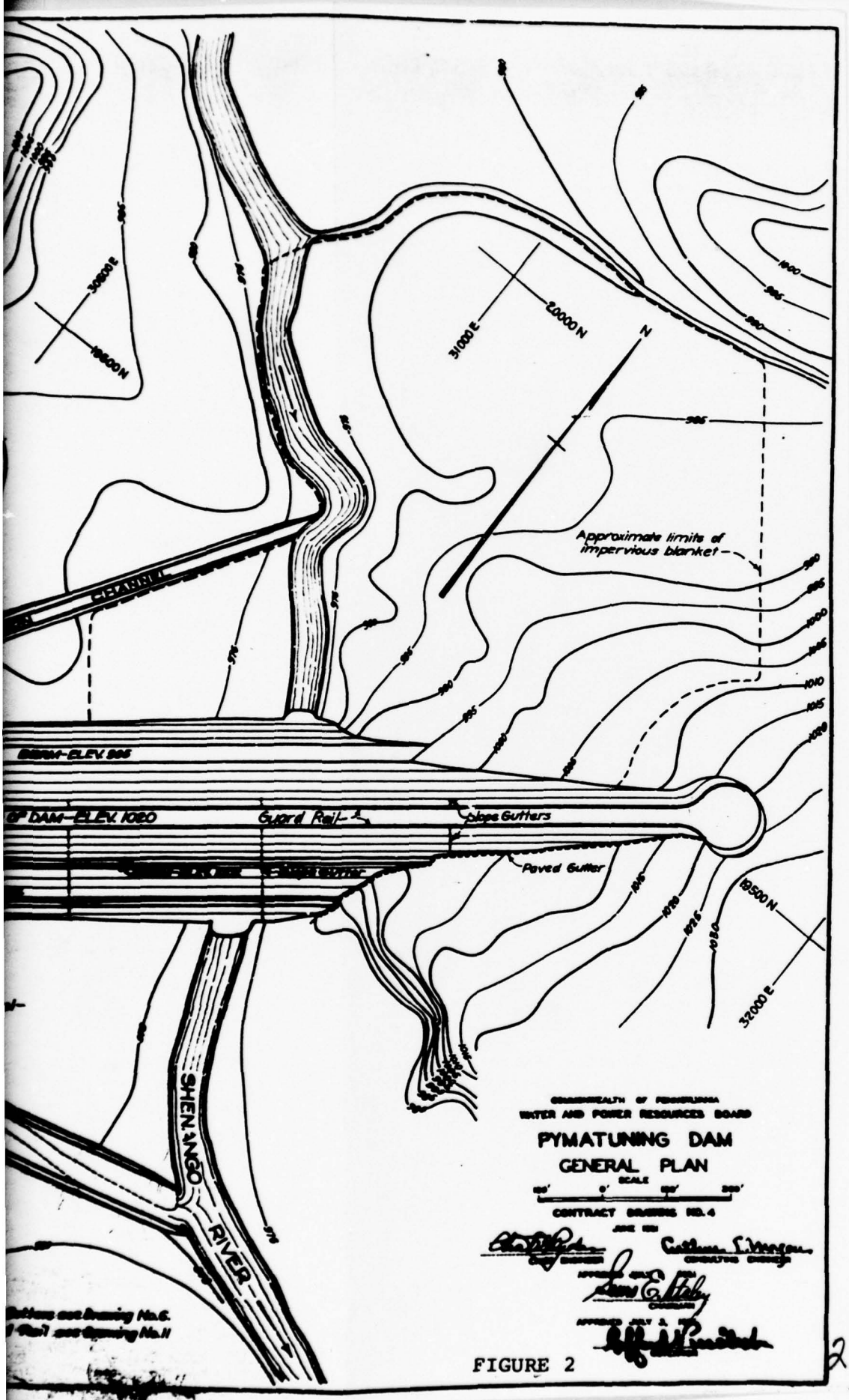
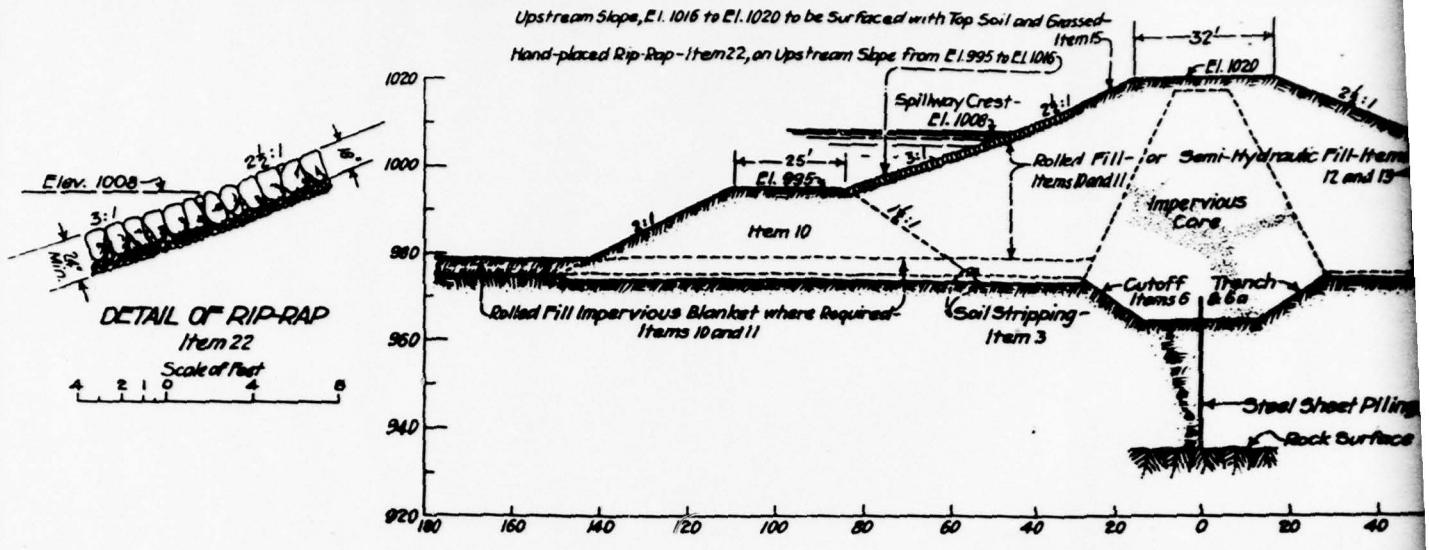
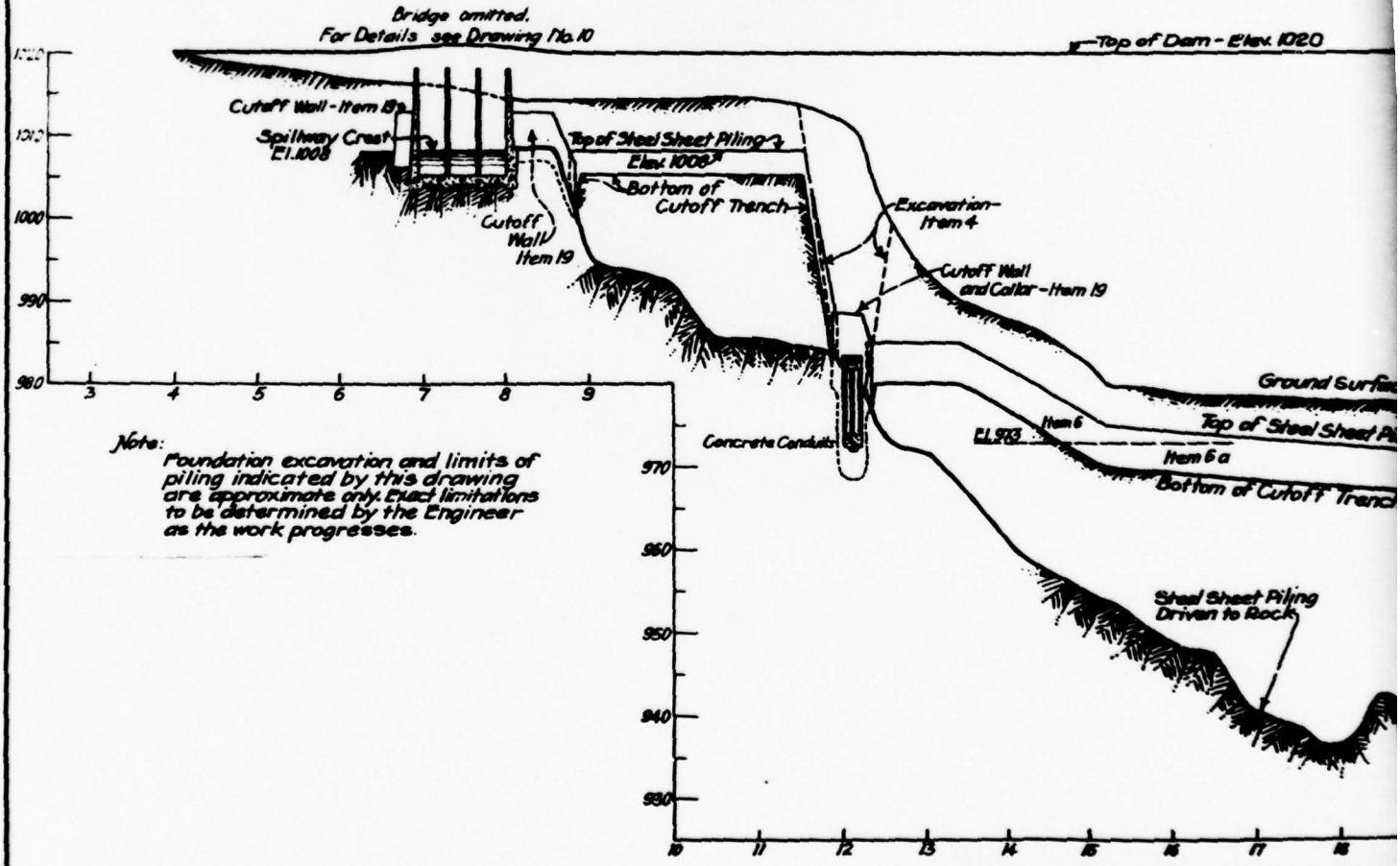

Approximate limits of impervious blanket
Guard Rail
Slope Gutters
Paved Gutter
SHENANGO RIVER
31000 E
20000 N
30600 E
19600 N
18500 N
32000 E
COMMONWEALTH OF PENNSYLVANIA
WATER AND POWER RESOURCES BOARD
PYMATUNING DAM
GENERAL PLAN
SCALE
CONTRACT DRAWING NO. 4

FIGURE 2

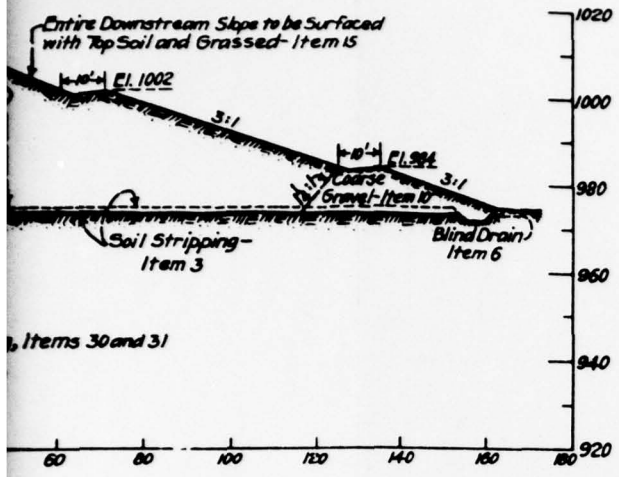


TYPICAL CROSS SECTION OF DA

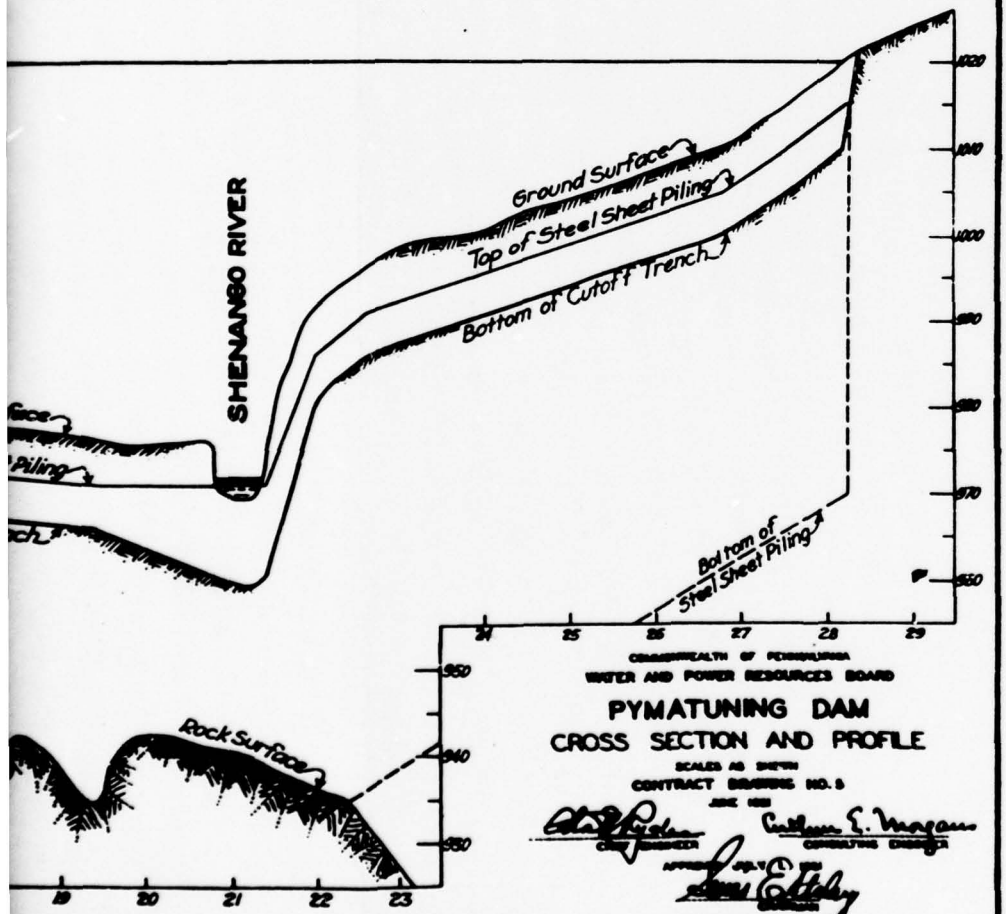


Note:
Foundation excavation and limits of piling indicated by this drawing are approximate only. Exact limitations to be determined by the Engineer as the work progresses.

PROFILE ALONG CENTER LINE



AM



COMMONWEALTH OF PENNSYLVANIA
WATER AND POWER RESOURCES BOARD

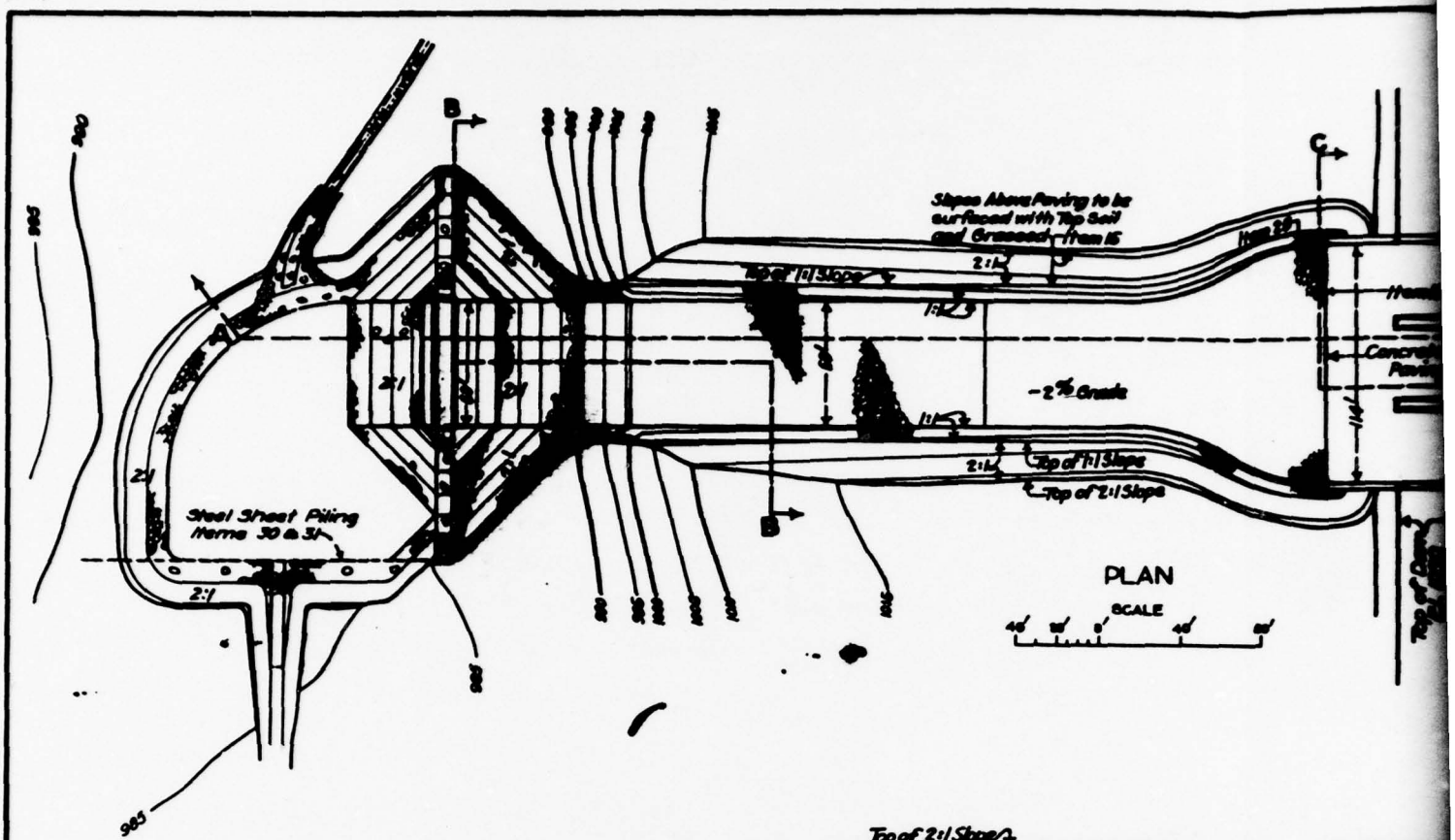
PYMATUNING DAM
CROSS SECTION AND PROFILE

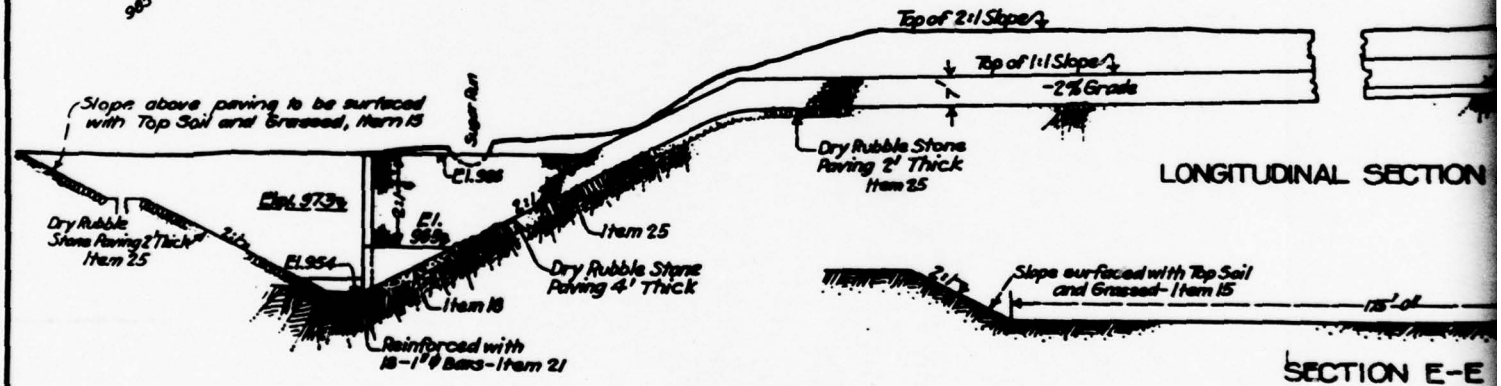
SCALES AS SHOWN
CONTRACT DRAWING NO. 5
DEC 1933

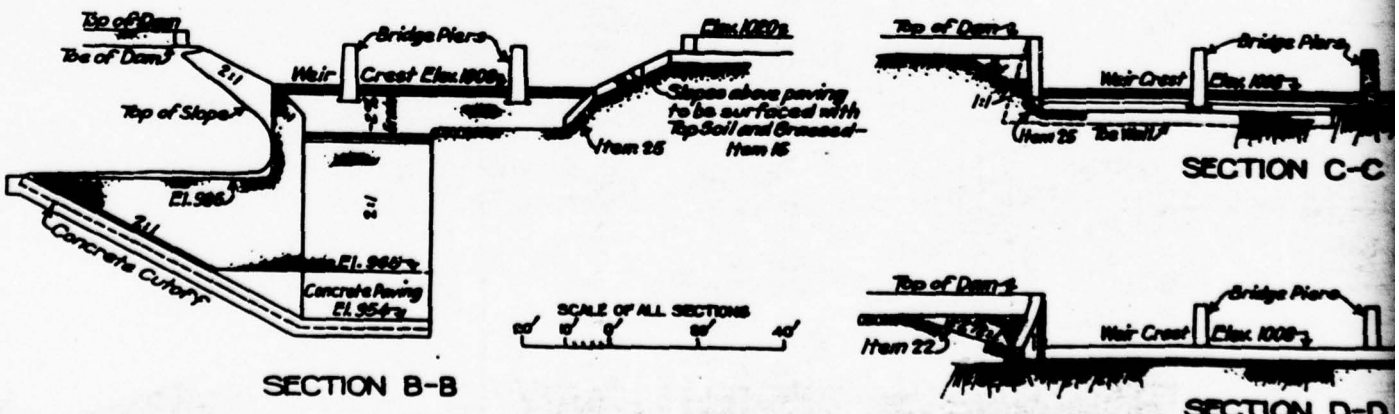
E OF DAM

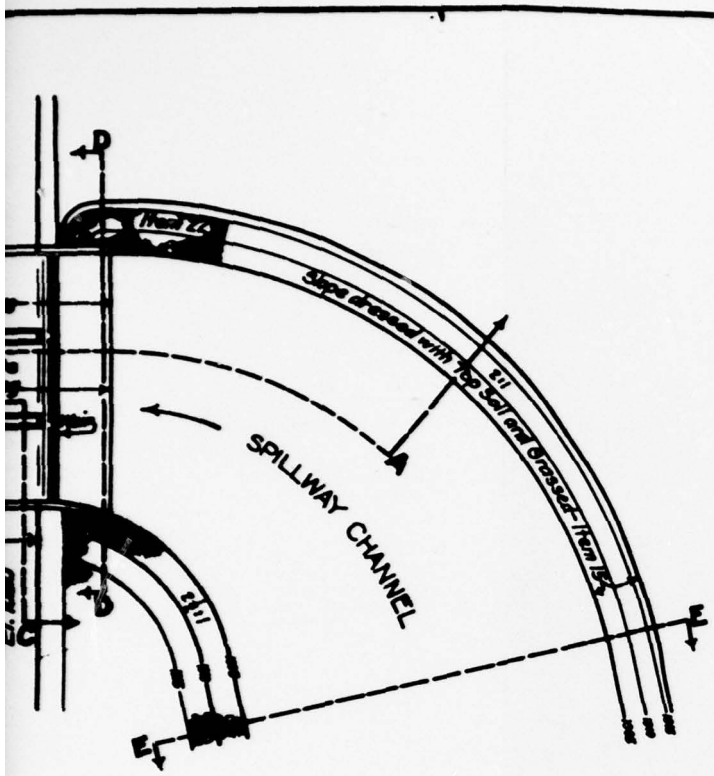
FIGURE 3

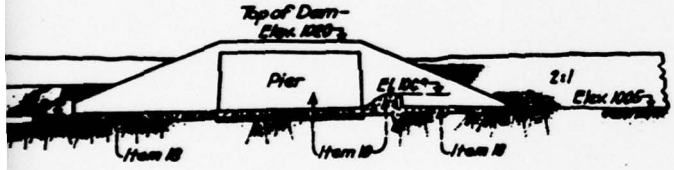
2


Slopes Above Paving to be surfaced with Top Soil and Grassed - Item 15
Top of 1:1 Slope
2:1
1:1
-2% Grade
Top of 1:1 Slope
Top of 2:1 Slope
Steel Sheet Piling Items 30 & 31
PLAN
SCALE
40' 20' 0' 40' 80'

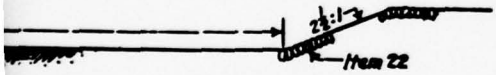

Top of 2:1 Slope
Top of 1:1 Slope
-2% Grade
Slope above paving to be surfaced with Top Soil and Grassed, Item 15
Dry Rubble Stone Paving 2' Thick Item 25
LONGITUDINAL SECTION
Dry Rubble Stone Paving 2' Thick Item 25
Item 25
Dry Rubble Stone Paving 4' Thick
Item 18
Reinforced with 18-1" ø Bars - Item 21
Slope surfaced with Top Soil and Grassed - Item 15
SECTION E-E

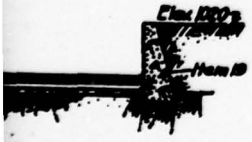

Top of Dam
Toe of Dam
Bridge Piers
Weir
Crest Elev. 1008
Top of Slope
Item 25
Slopes above paving to be surfaced with Top Soil and Grassed - Item 15
Concrete Cutoff
Concrete Paving
SECTION B-B
SCALE OF ALL SECTIONS
Weir Crest
Item 25
SECTION C-C
Item 22
SECTION D-D





A-A





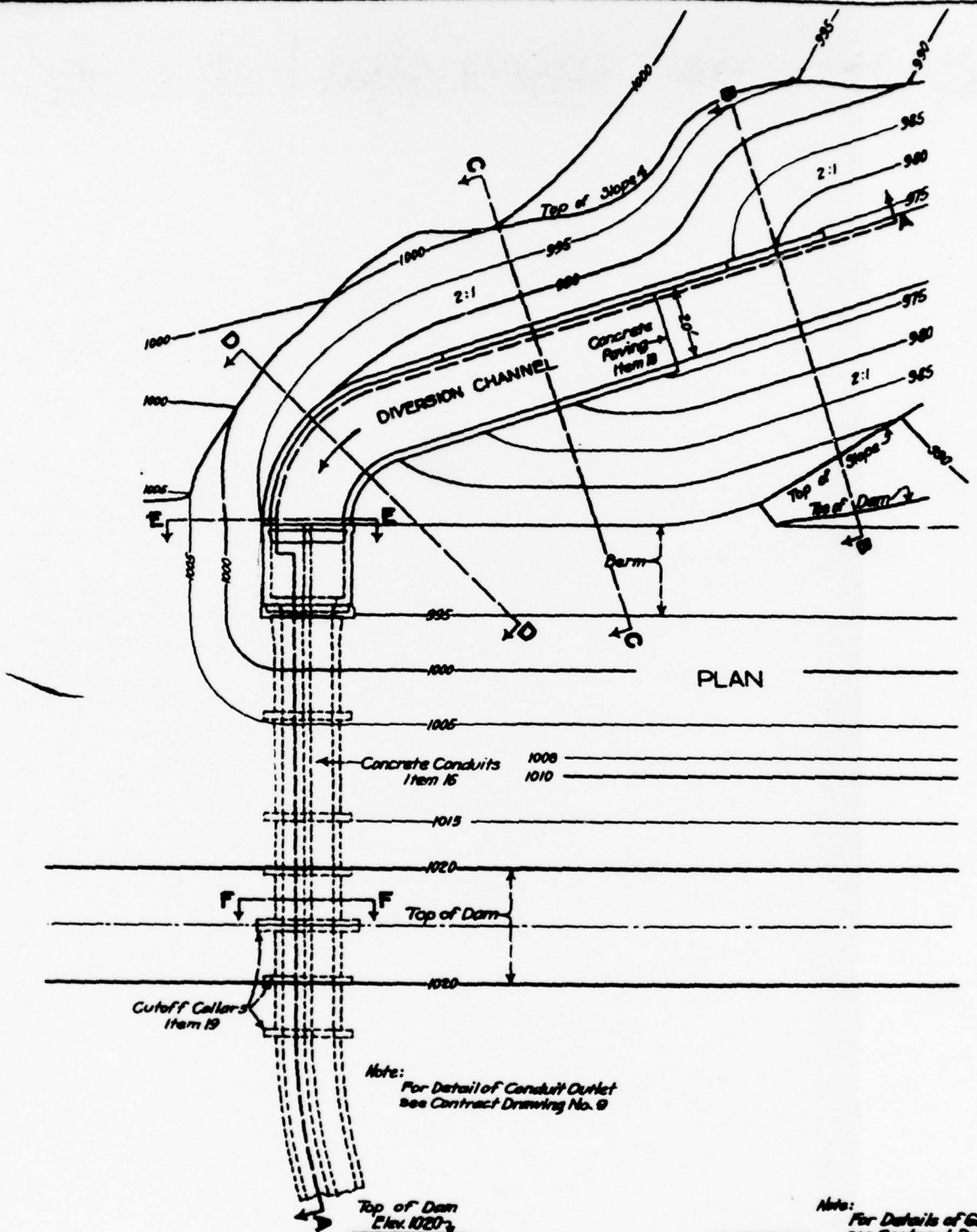
COMMONWEALTH OF PENNSYLVANIA
WATER AND POWER RESOURCES BOARD

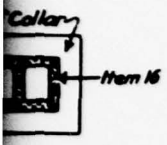
PYMATUNING DAM
SPILLWAY

SCALES AS SHOWN
CONTRACT DRAWING NO. 7

JUNE 1935

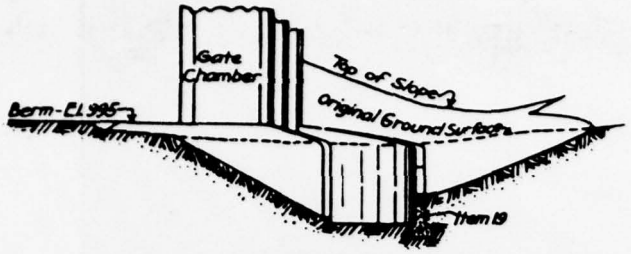
FIGURE 4


Top of Slope 4
2:1
DIVERSION CHANNEL
Concrete Paving Item 18
Slope 3
Top of Dam
Dam
PLAN
Concrete Conduits Item 16
Cutoff Collars Item 19
Note:
For Detail of Conduit Outlet see Contract Drawing No. 9
Top of Dam Elev. 1020
Cutoff Collars Item 18
Conduit
Note:
For Details of Gate Chamber see Contract Drawing No. 9
Original Ground Surface
LONGITUDINAL SECTION A-A

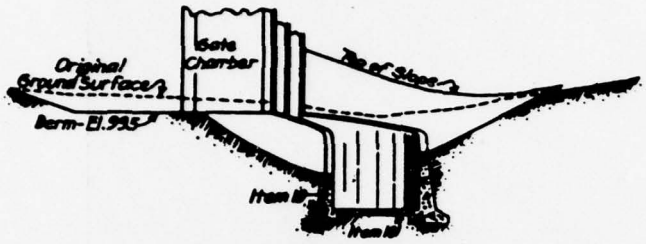


ON F-F

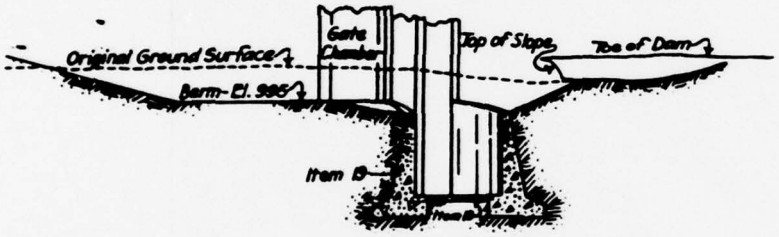
ft. x 8 ft.
walls 24 inches,
as Required.
m 21



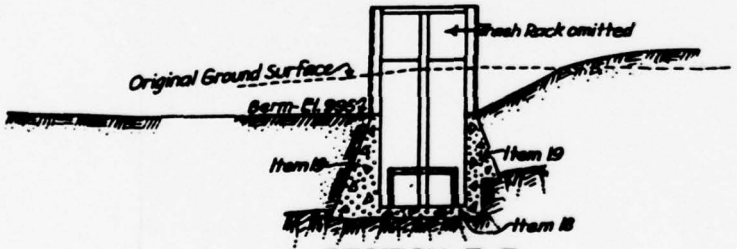
SECTION B-B



SECTION C-C



SECTION D-D



SECTION E-E

face along Section Line

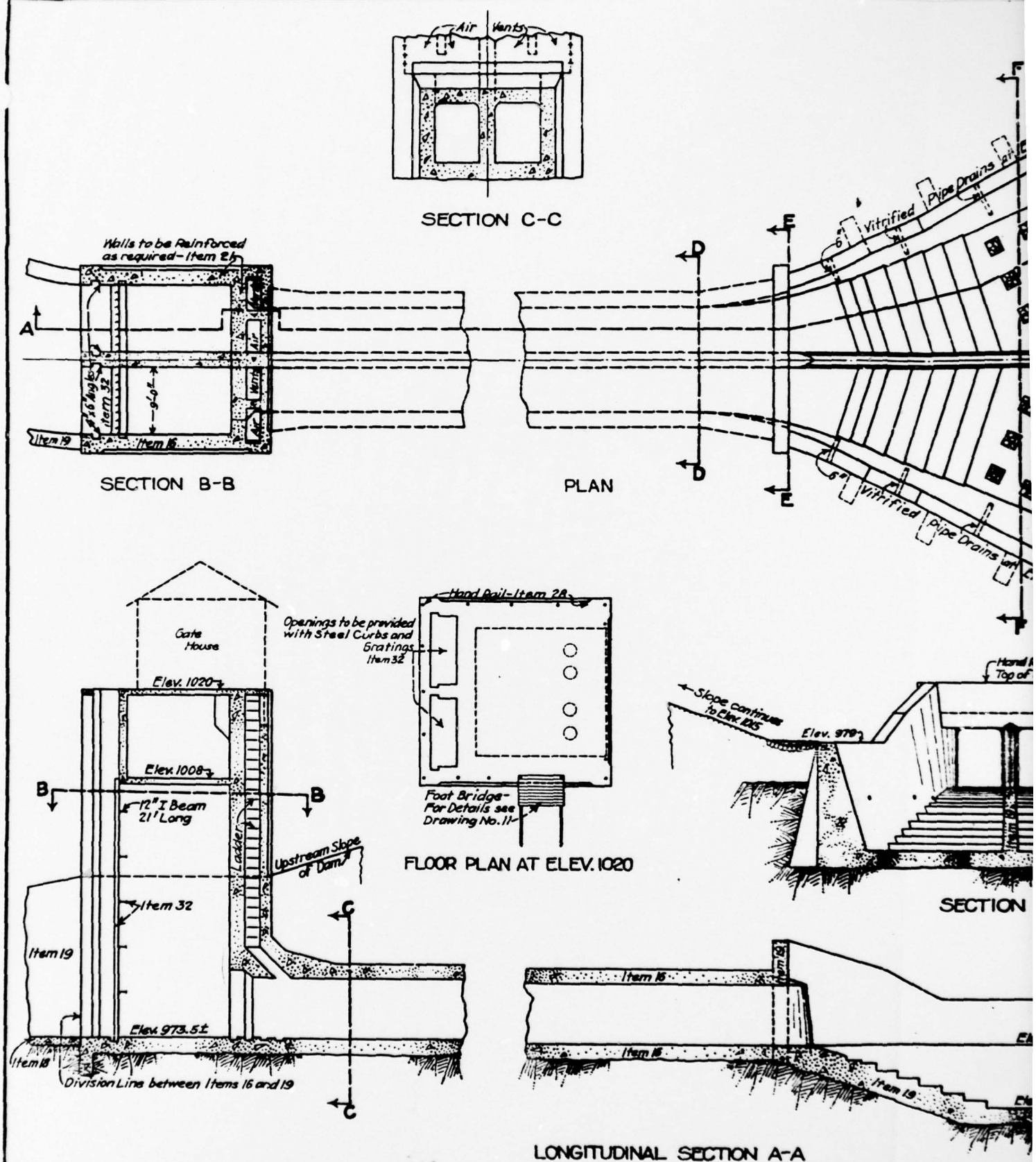
COMMONWEALTH OF PENNSYLVANIA
WATER AND POWER RESOURCES BOARD

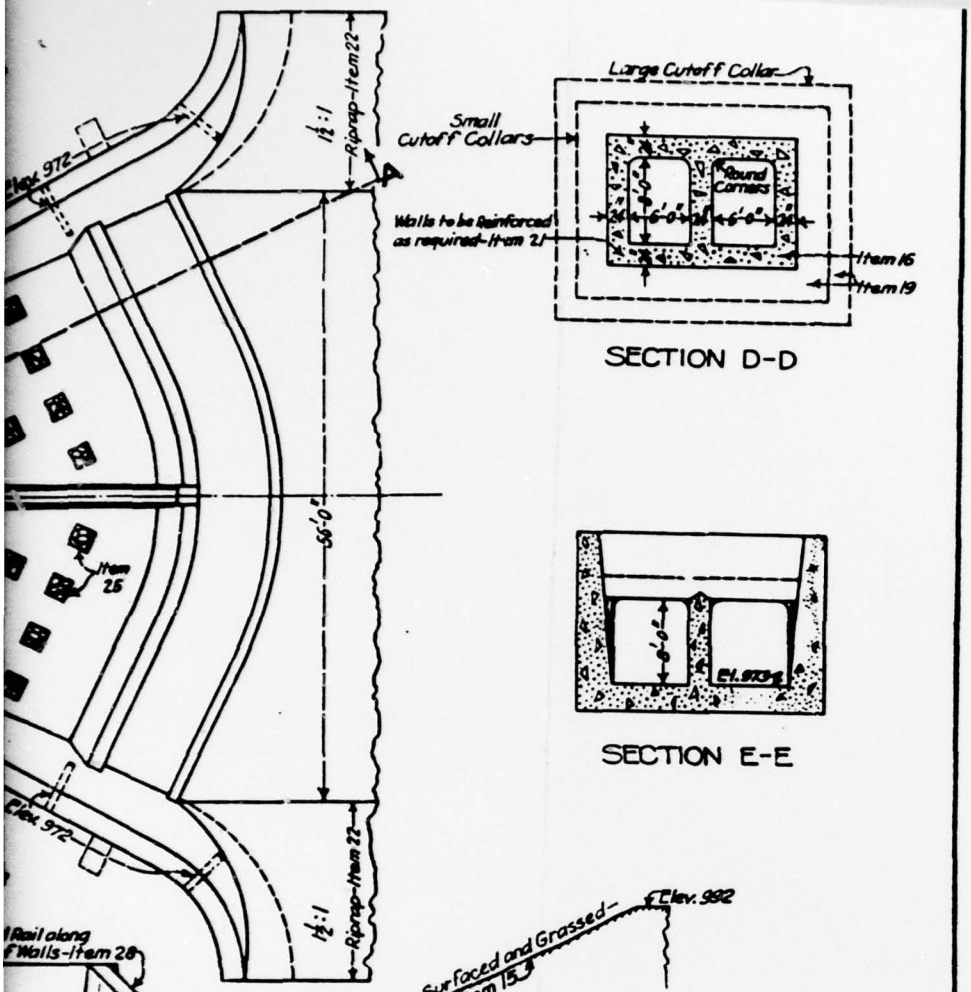
PYMATUNING DAM
CONDUITS

SCALE

CONTRACT DRAWING NO. 6

FIGURE 5


Air Vents
SECTION C-C
Walls to be Reinforced as required - Item 24
Item 32
Item 19
Item 16
SECTION B-B
Vitrified Pipe Drains
PLAN
Gate House
Elev. 1020
Elev. 1008
12" I Beam 21' Long
Ladder
Upstream Slope of Dam
Item 32
Item 19
Elev. 973.5±
Item 18
Division Line between Items 16 and 19
Openings to be provided with Steel Curbs and Gratings Item 32
Hand Rail - Item 28
Foot Bridge - For Details see Drawing No. 11
FLOOR PLAN AT ELEV. 1020
Slope continues to Elev. 1015
Elev. 979
SECTION
Item 16
Item 19
LONGITUDINAL SECTION A-A



COMMONWEALTH OF PENNSYLVANIA
WATER AND POWER RESOURCES BOARD

PYMATUNING DAM
CONDUIT ENTRANCE AND OUTLET

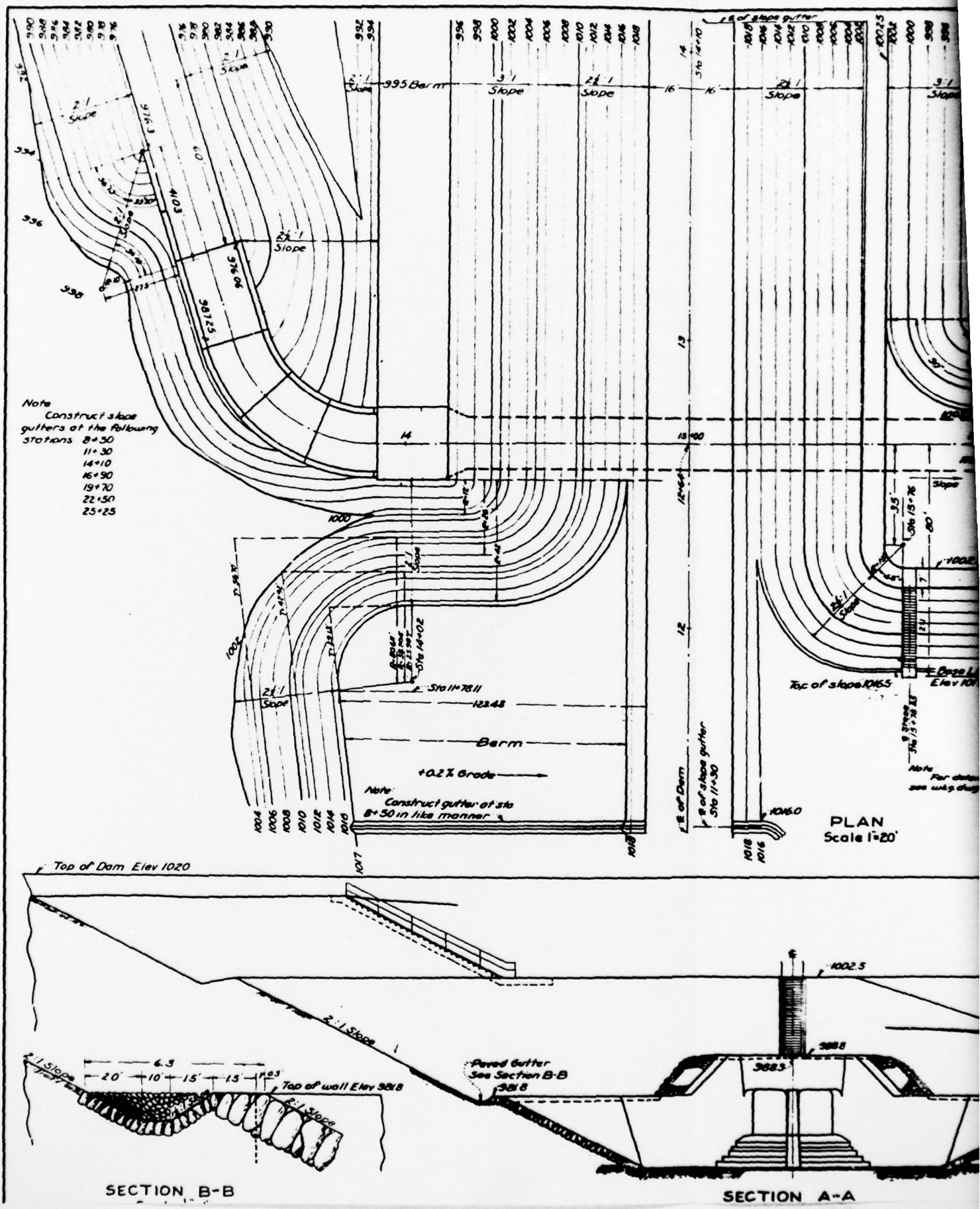
SCALE

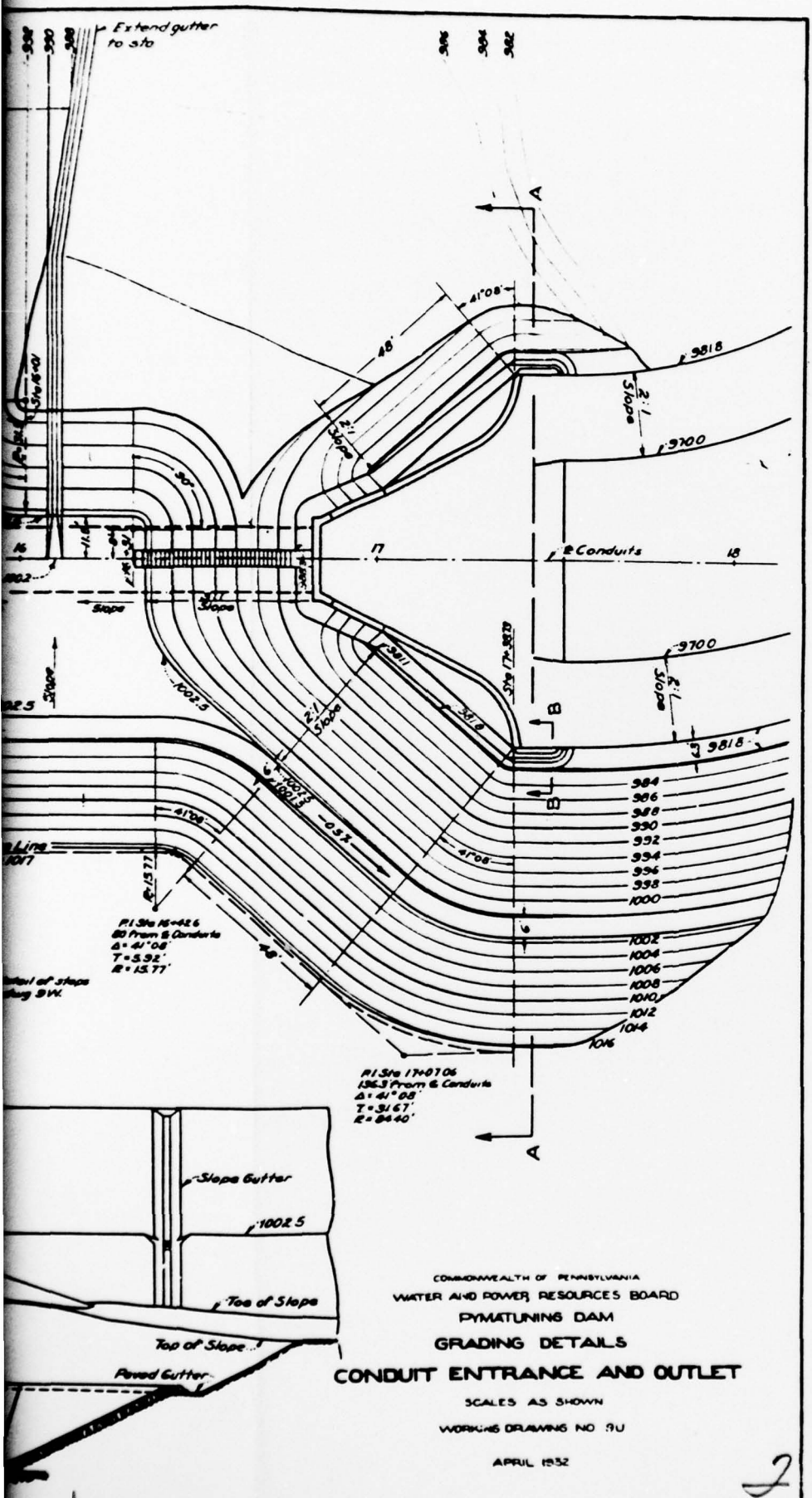
CONTRACT DRAWING NO. 9

APPROVED JULY 1, 1936

APPROVED JULY 1, 1936

FIGURE 6


Note
Construct slope gutters at the following stations 8+50
11+30
14+10
16+90
19+70
22+50
25+25
995 Berm
2:1 Slope
3:1 Slope
2½:1 Slope
Berm
+0.2% Grade
Note
Construct gutter at sta 8+50 in like manner
Toe of slope 1016.5
1016.0
PLAN
Scale 1"=20'
Top of Dam Elev 1020
2:1 Slope
Paved Gutter
See Section B-B
1002.5
Top of wall Elev 981.8
SECTION B-B
SECTION A-A



COMMONWEALTH OF PENNSYLVANIA

WATER AND POWER RESOURCES BOARD

PYMATUNING DAM

GRADING DETAILS

CONDUIT ENTRANCE AND OUTLET

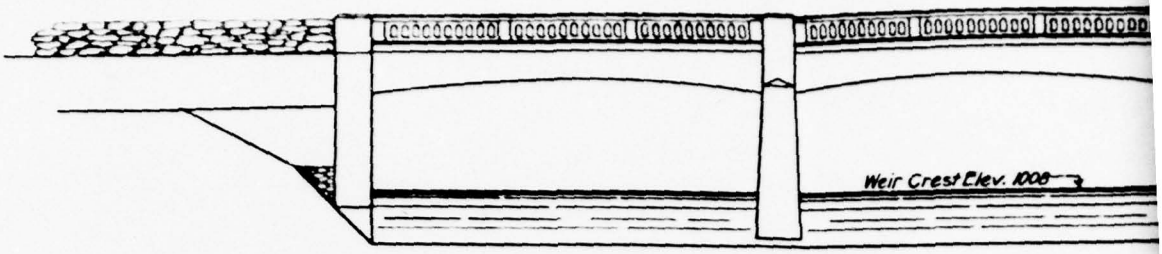
SCALES AS SHOWN

WORKING DRAWING NO 9U

APRIL 1952

2

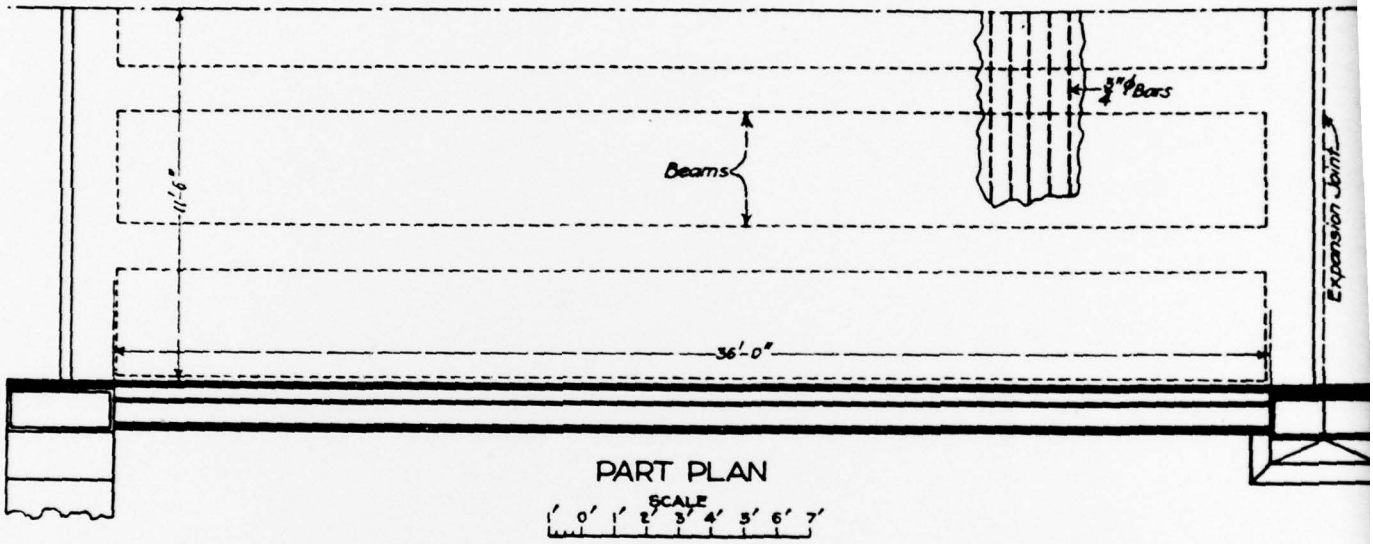
FIGURE 7



ELEVATION

SCALE

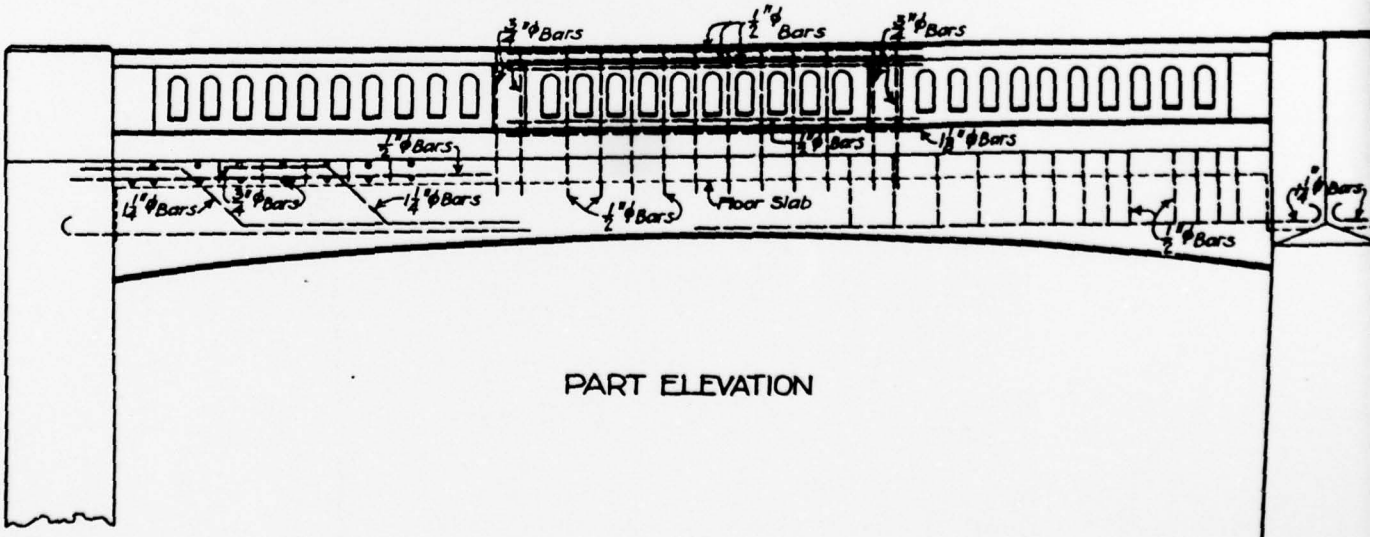
8' 4' 0' 8' 16'



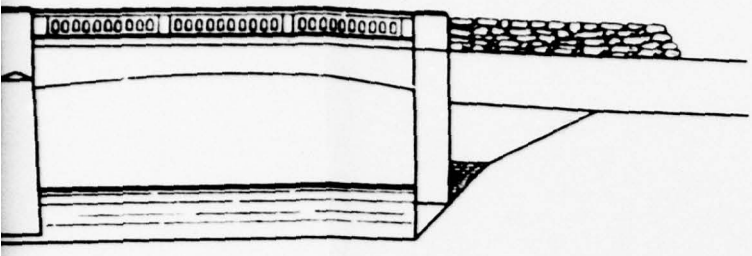
PART PLAN

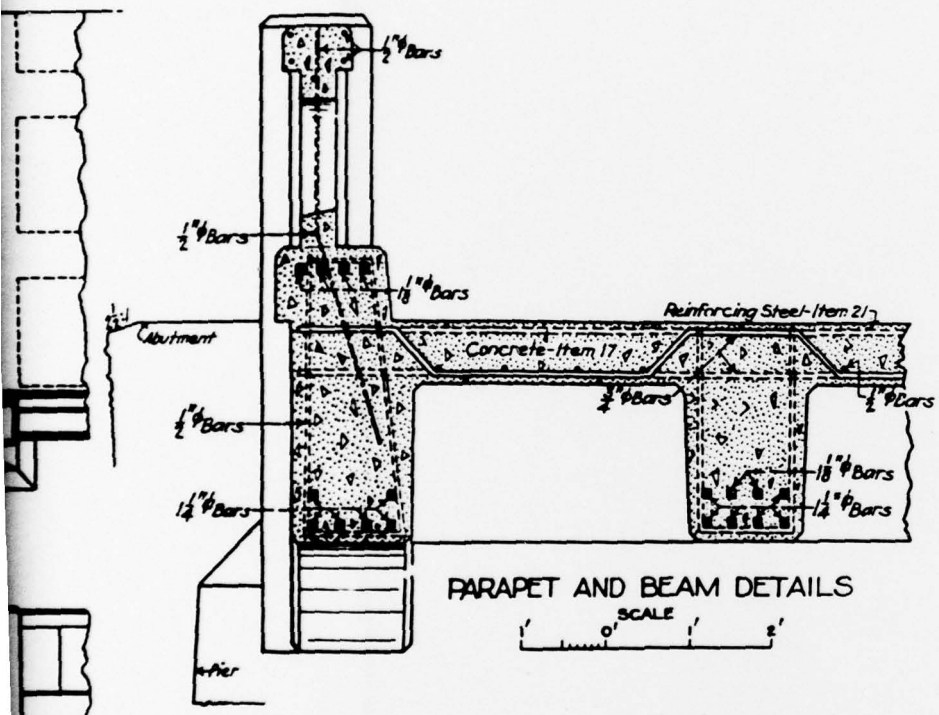
SCALE

1' 0' 1' 2' 3' 4' 5' 6' 7'



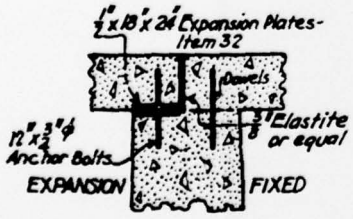
PART ELEVATION

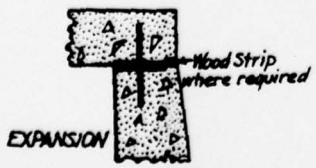




PARAPET AND BEAM DETAILS

SCALE 1' 0' 1' 2'





EXPANSION DETAILS

COMMONWEALTH OF PENNSYLVANIA
WATER AND POWER RESOURCES BOARD

PYMATUNING DAM
SPILLWAY BRIDGE

SCALES AS SHOWN
CONTRACT DRAWING NO. 10

JUNE 1934

CHIEF ENGINEER

CONSULTING ENGINEER

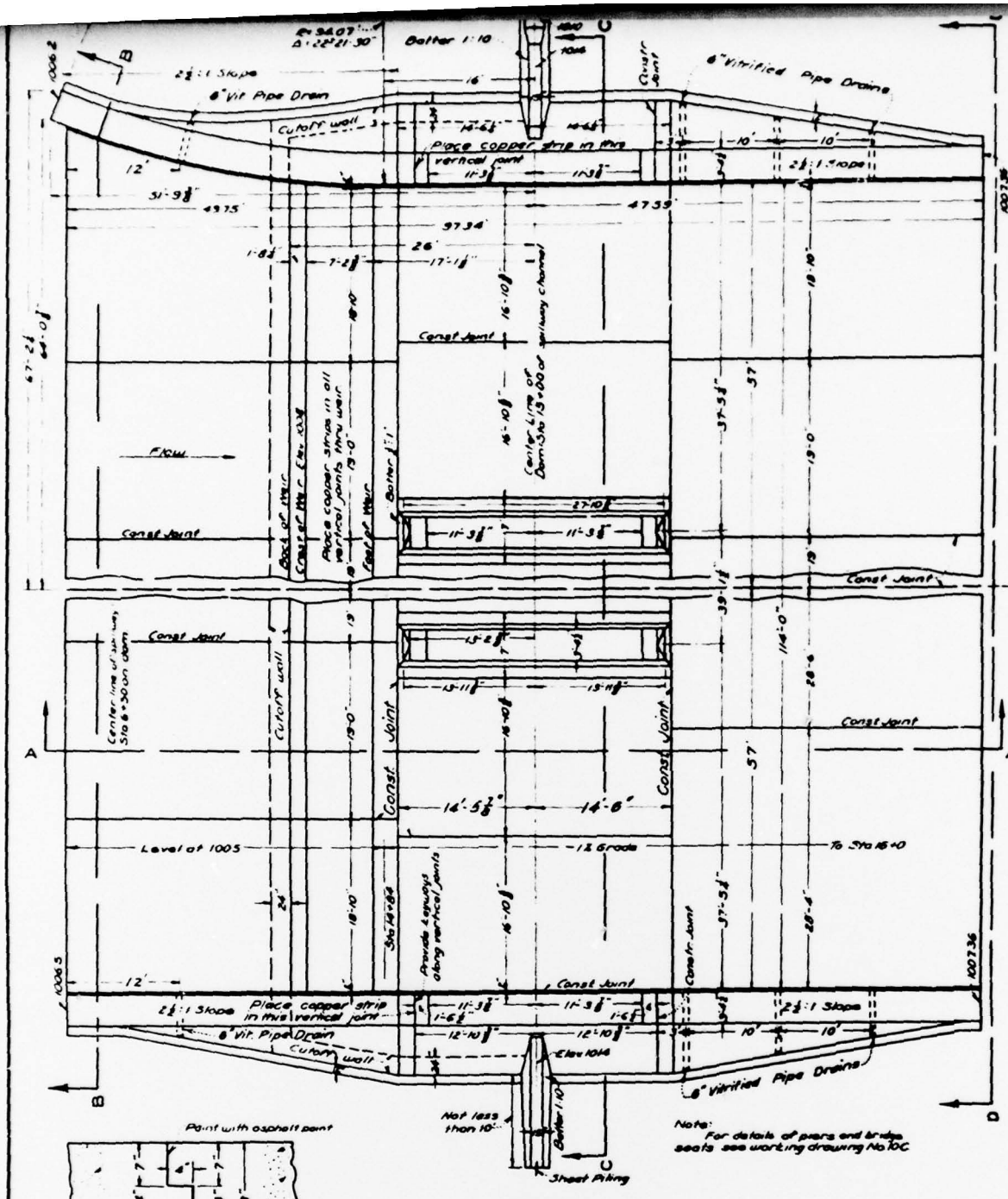
APPROVED JULY 7TH

COMMISSION

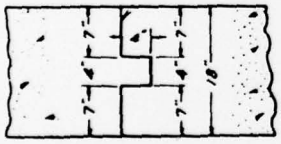
APPROVED JULY 3RD

SECRETARY

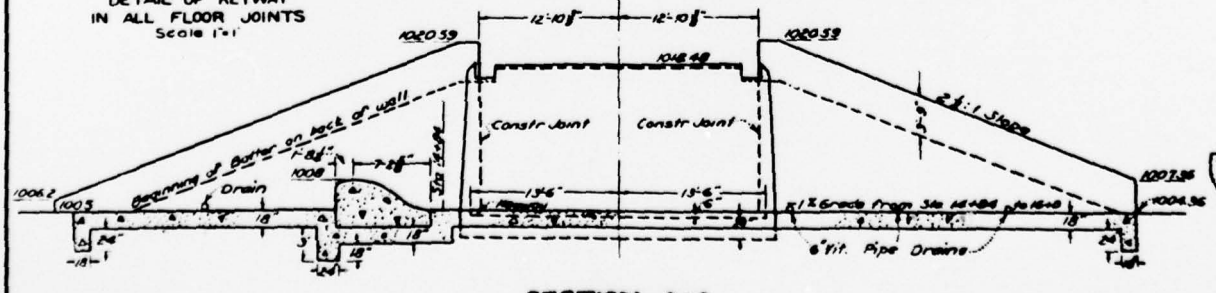
JRE 8



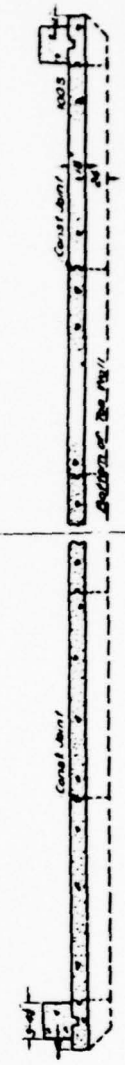
PLAN
Scale ⅛"=1'



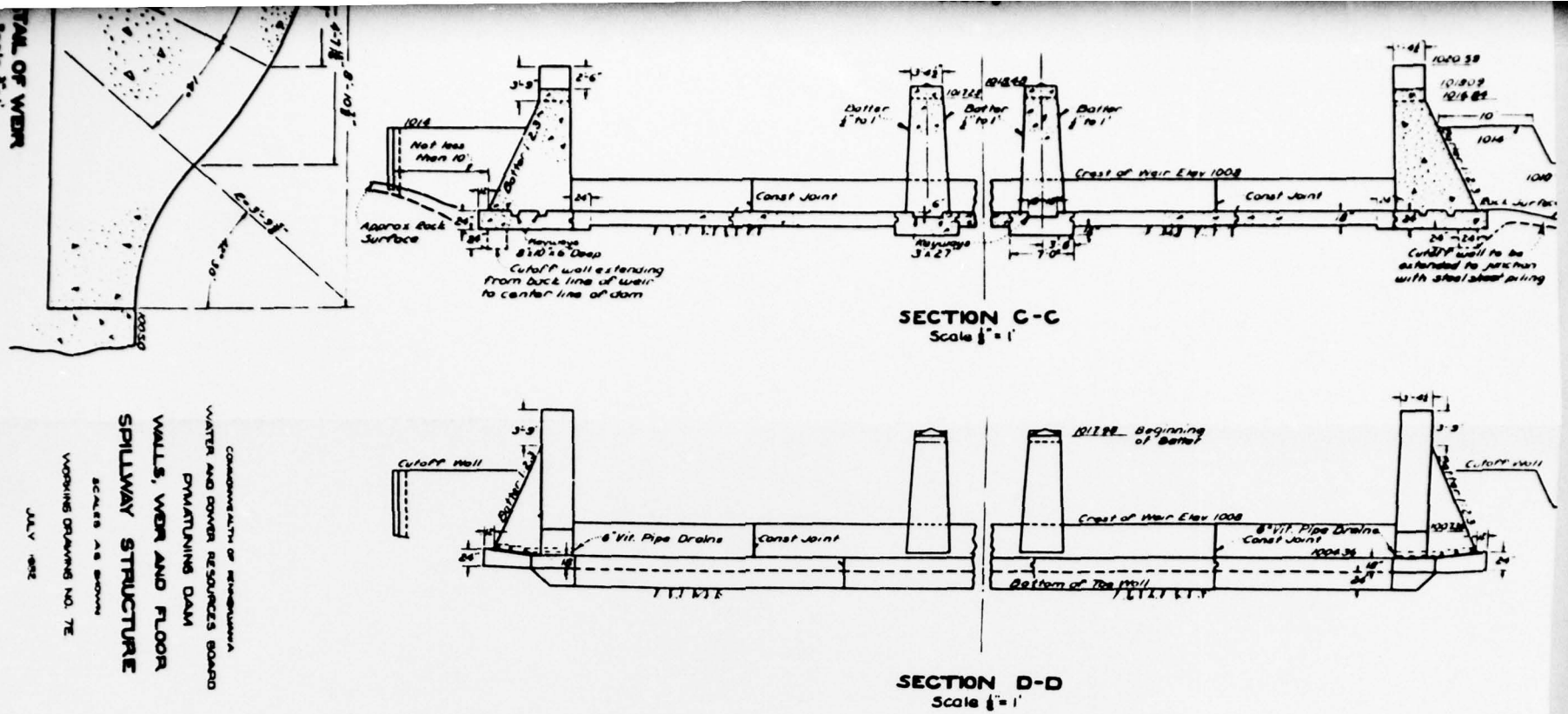
DETAIL OF KEYWAY
IN ALL FLOOR JOINTS
Scale 1"=1'



SECTION A-A
Scale ⅛"=1'



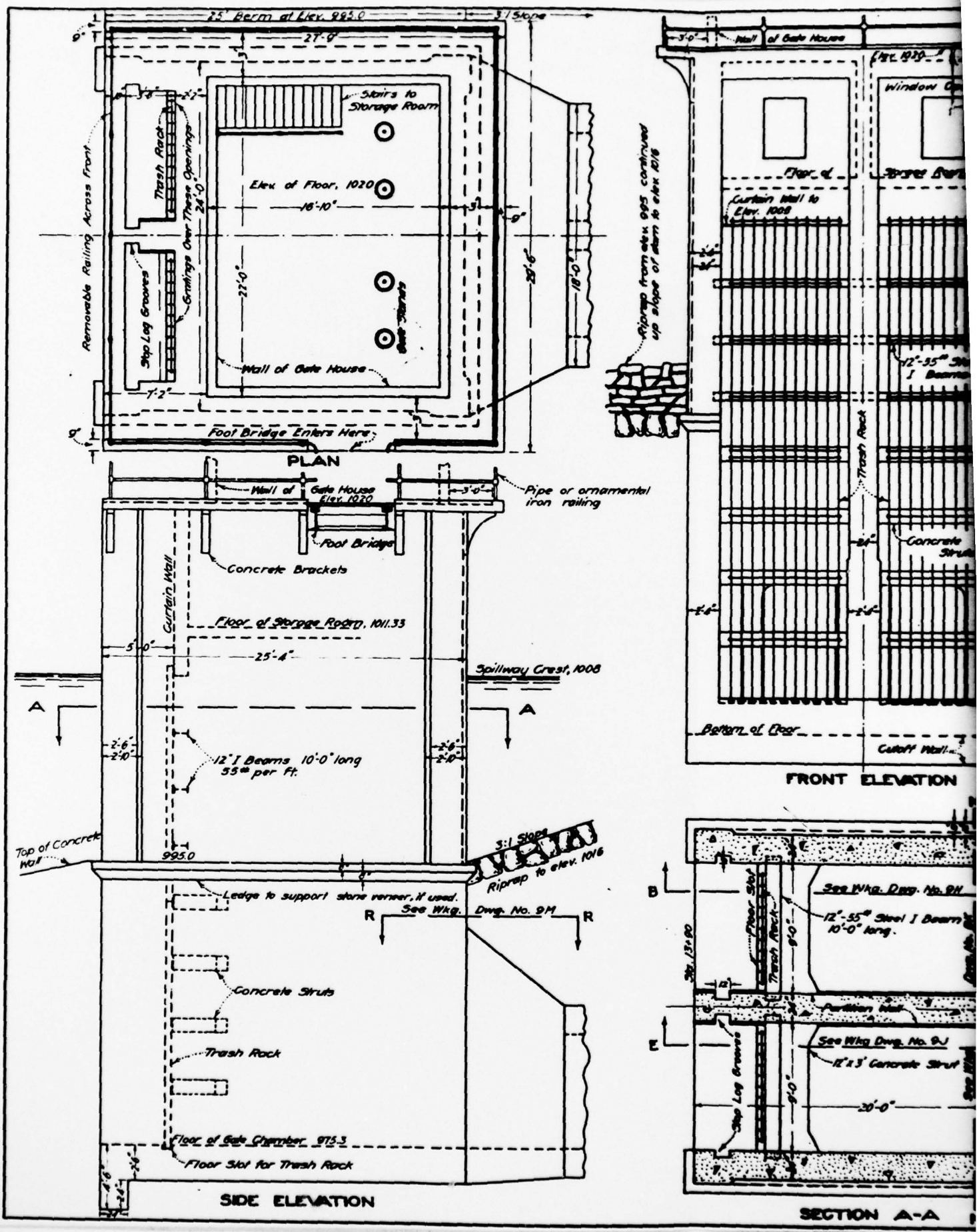
SECTION B-B

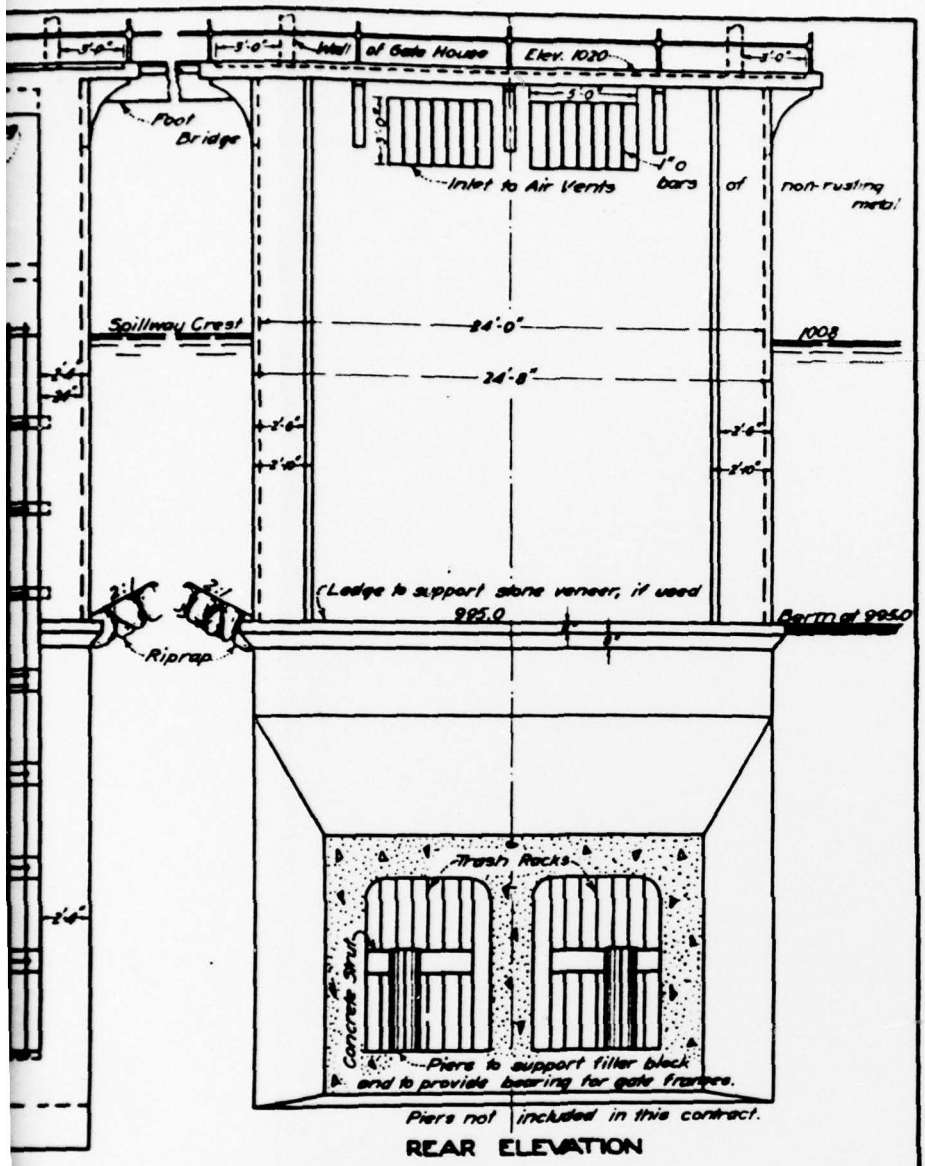


COMMONWEALTH OF PENNSYLVANIA
WATER AND POWER RESOURCES BOARD
DYMATUNING DAM
WALLS, WEIR AND FLOOR
SPILLWAY STRUCTURE
SCALES AS SHOWN
WORKING DRAWING NO. 7E
JULY 1952

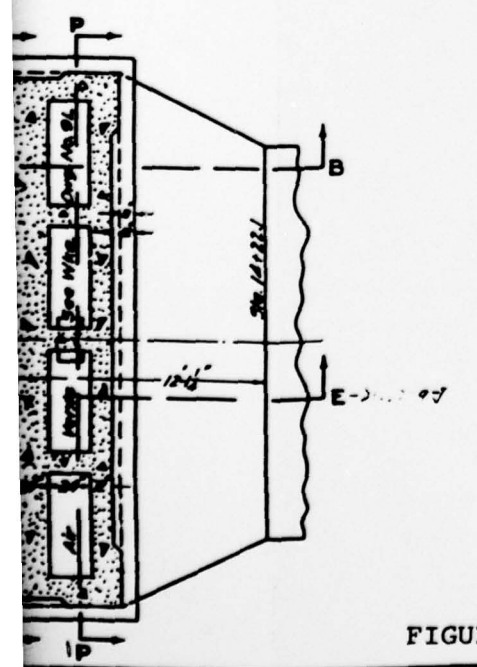
FIGURE 9

2


25' Berm at Elev. 995.0
3:1 Slope
27'-0"
Stairs to Storage Room
Trash Rack
Elev. of Floor, 1020
16'-10"
24'-0"
22'-0"
Step Log Grooves
Gratings Over These Openings
Removable Railing Across Front
Wall of Gate House
7'-2"
Foot Bridge Enters Here
PLAN
Wall of Gate House Elev. 1020
Pipe or ornamental iron railing
Foot Bridge
Concrete Brackets
Curtain Wall
Floor of Storage Room, 1011.33
25'-4"
Spillway Crest, 1008
12" I Beams 10'-0" long 55# per ft.
Top of Concrete Wall
995.0
3:1 Slope
Riprap to elev. 1016
Ledge to support stone veneer, if used.
See Wkg. Dwg. No. 9M
Concrete Struts
Trash Rock
Floor of Gate Chamber 975.3
Floor Slot for Trash Rack
SIDE ELEVATION
Riprap from elev. 995 continues up slope or stairs to elev. 1016
Wall of Gate House
Elev. 1020
Curtain Wall to Elev. 1008
Floor of
Trash Rack
Concrete
Bottom of Door
Cutoff Wall
FRONT ELEVATION
See Wkg. Dwg. No. 9H
12"-55# Steel I Beam 10'-0" long.
Floor Slot
Trash Rack
Partition Wall
See Wkg Dwg. No. 9J
12" x 3' Concrete Strut
Step Log Grooves
20'-0"
SECTION A-A



REAR ELEVATION



PYMATUNING DAM
CONDUIT ENTRANCE

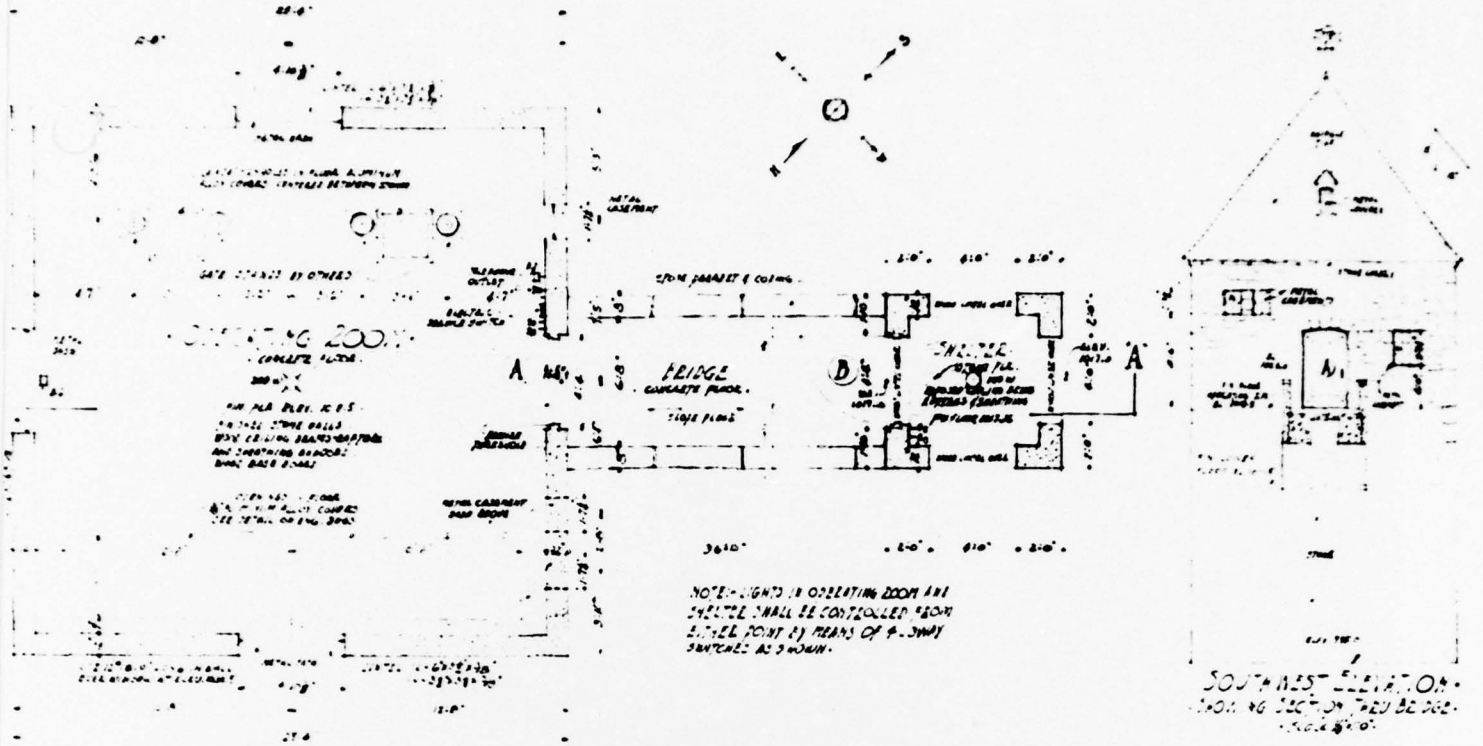
WORKING DRAWING NO 9 G

Scale $\frac{1}{4}$" = 1'

Feb 20, 1932

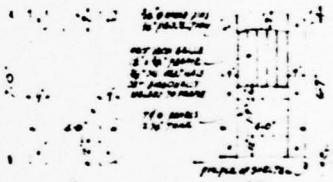
FIGURE 10

92

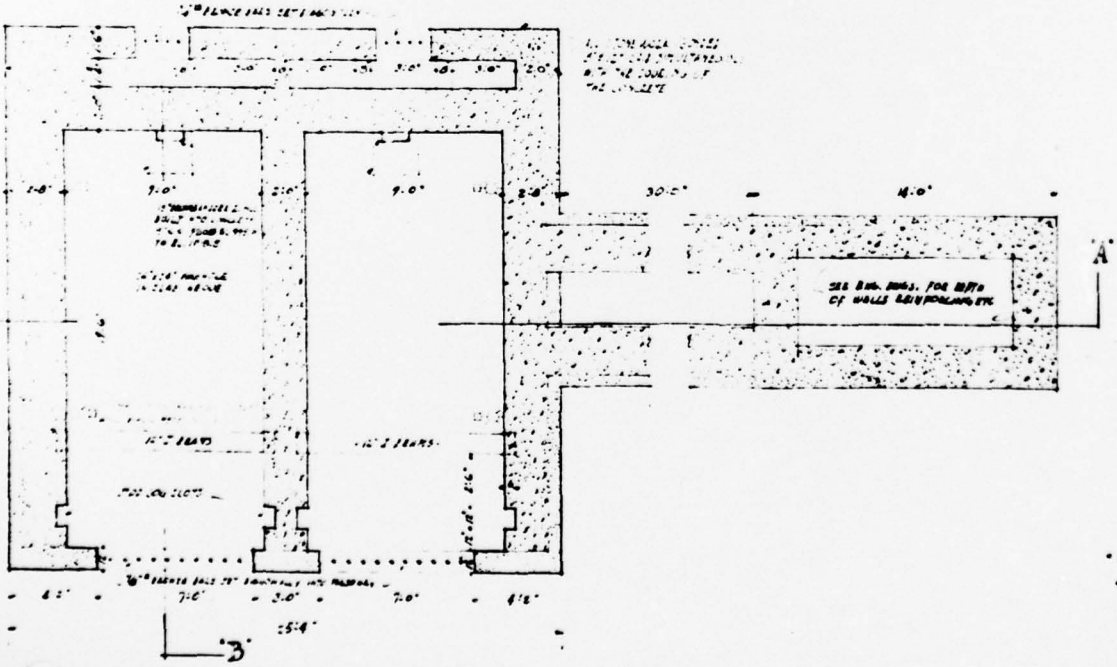


SOUTH WEST ELEVATION.
SHOWING SECTION THRU BRIDGE.
SCALE 1/4"=1'0"

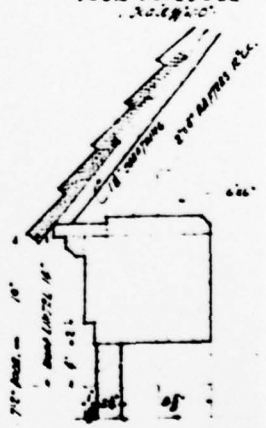
PLAN OF OPERATING ROOM & SHELTER.
SHOWING CONNECTING BRIDGE.
SCALE 1/4"=1'0"



SOUTH SIDE OF ROOF B.
SCALE 1/4"=1'0"

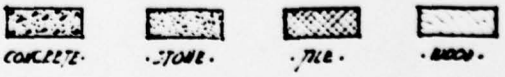


PLAN BELOW OPERATING ROOM.
SCALE 1/4"=1'0"

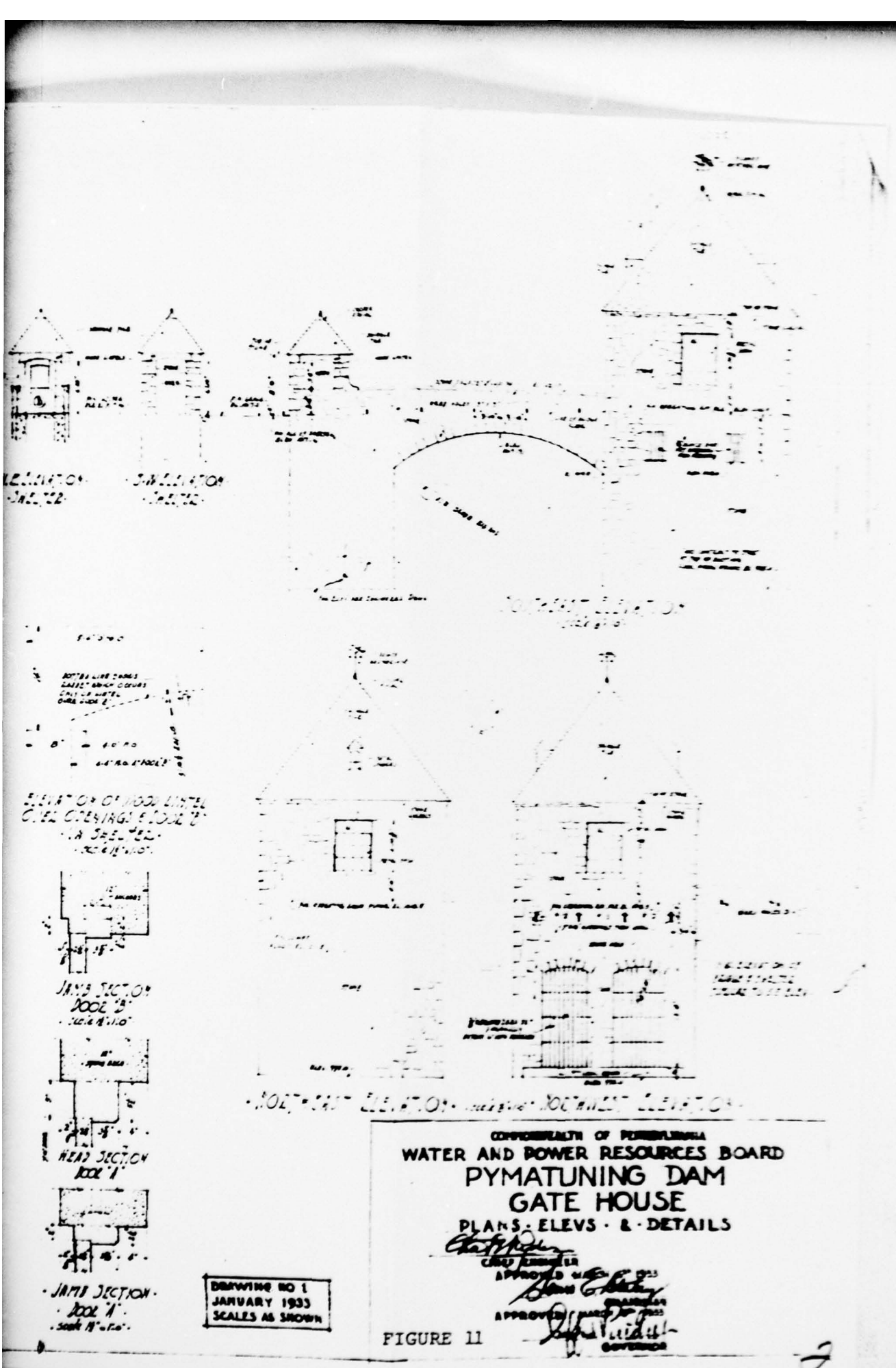


SECTION THRU SHAFTS AT SHELTER AND HEAD OF ROOF B.
SCALE 1/4"=1'0"

INDICATIONS OF MATERIALS.



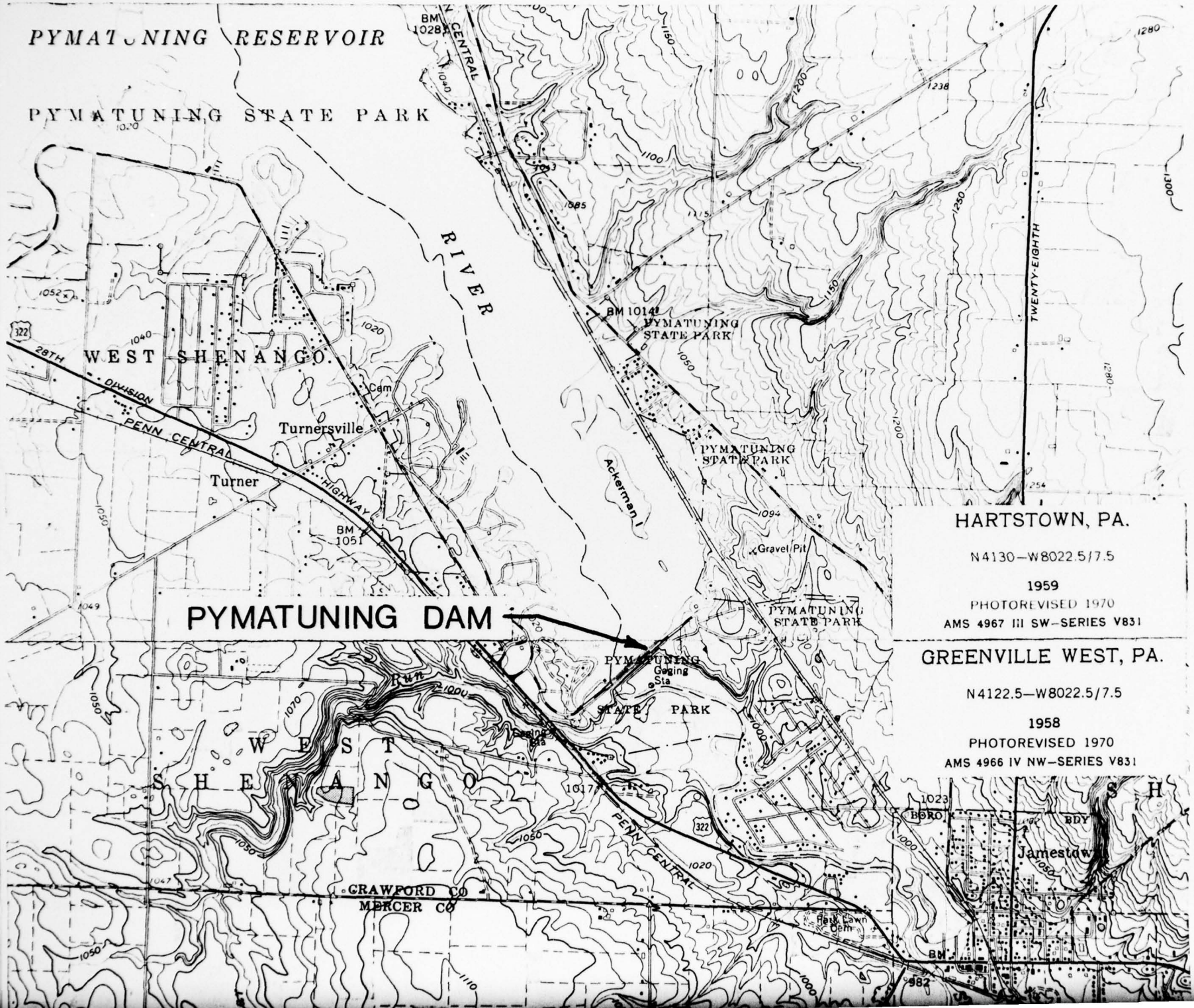
NOTE:- SEE ENGINEERS DRAWINGS FOR OTHER CONSTRUCTION DETAILS - SIZES OF ALL BEAMS SLABS AND WALLS AND REINFORCING AND STRUCTURAL STEEL BELOW ELEVATION 104.8'



COMMONWEALTH OF PENNSYLVANIA
WATER AND POWER RESOURCES BOARD
PYMATUNING DAM
GATE HOUSE
PLANS · ELEVS · & · DETAILS

DRAWING NO 1
JANUARY 1933
SCALES AS SHOWN

FIGURE 11



HARTSTOWN, PA.

N4130—W8022.5/7.5

1959

PHOTOREVISED 1970

AMS 4967 III SW—SERIES V831

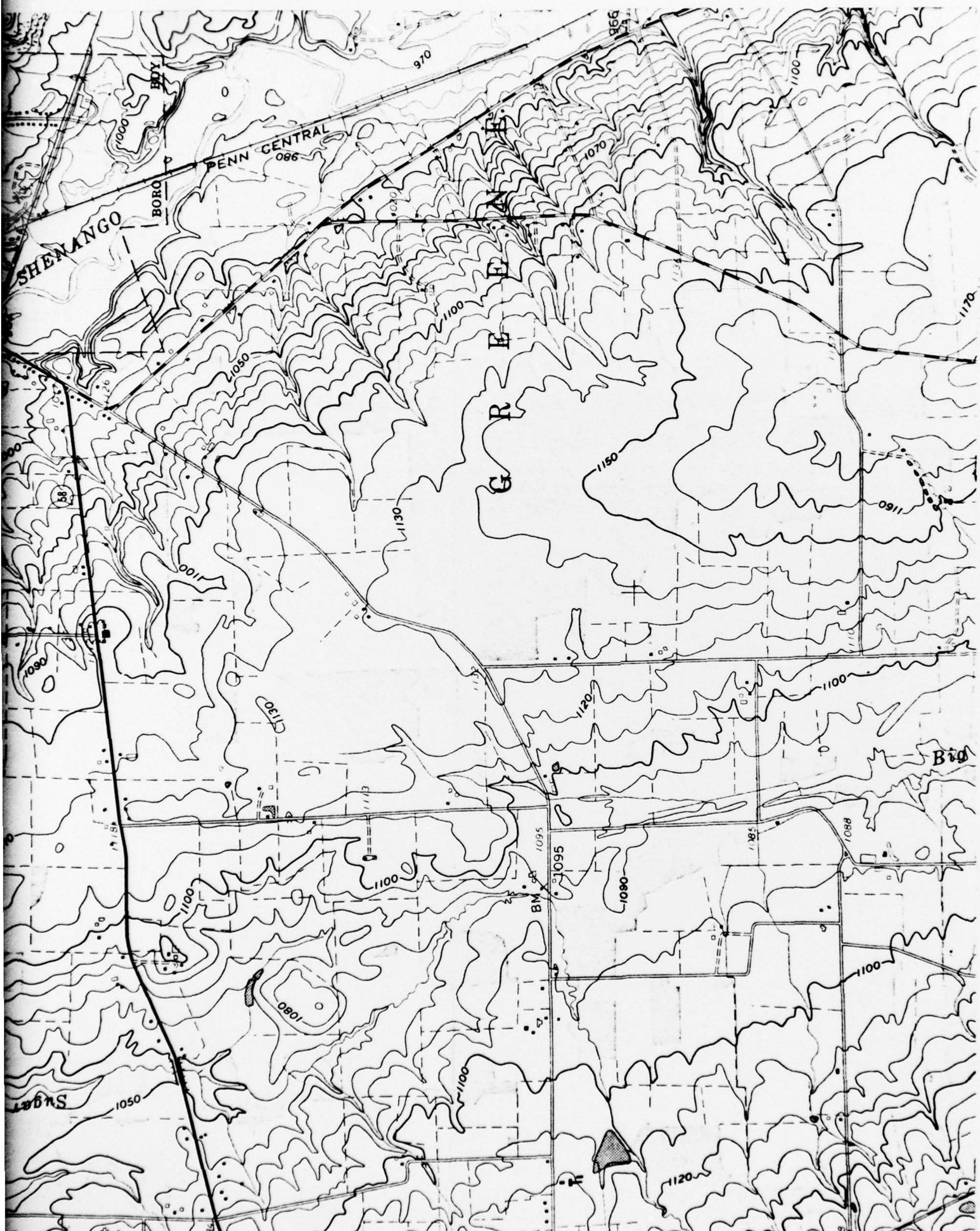
GREENVILLE WEST, PA.

N4122.5—W8022.5/7.5

1958

PHOTOREVISED 1970

AMS 4966 IV NW—SERIES V831


SHENANGO
BORO
PENN CENTRAL
Big
1100
1130
1150
1120
1095
1090
1050
1070
970
1000
1170
1200
1088
BM

2